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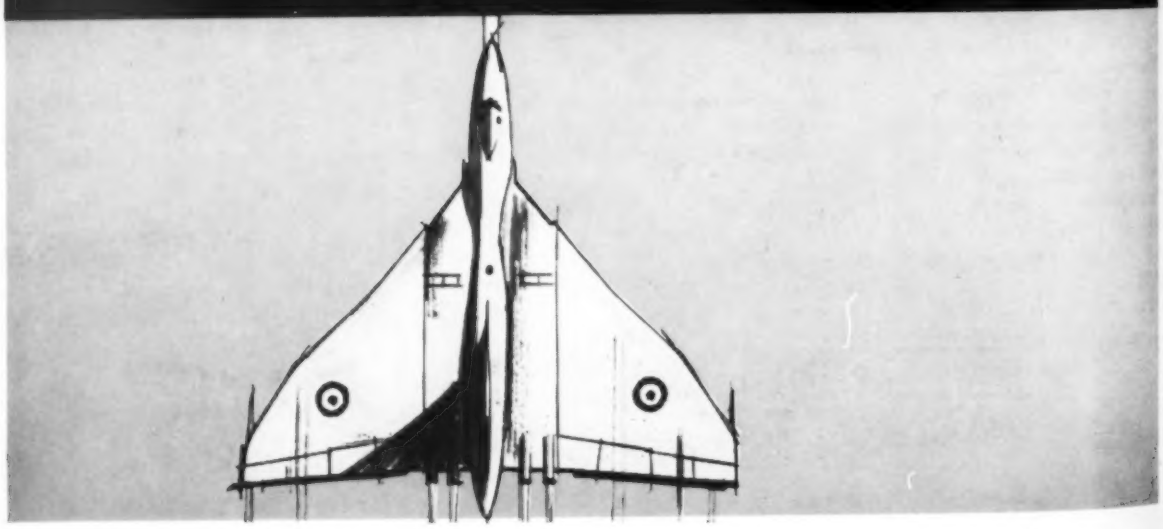

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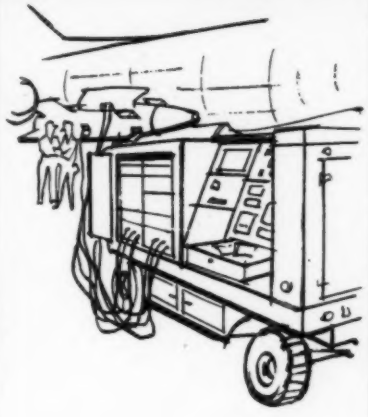

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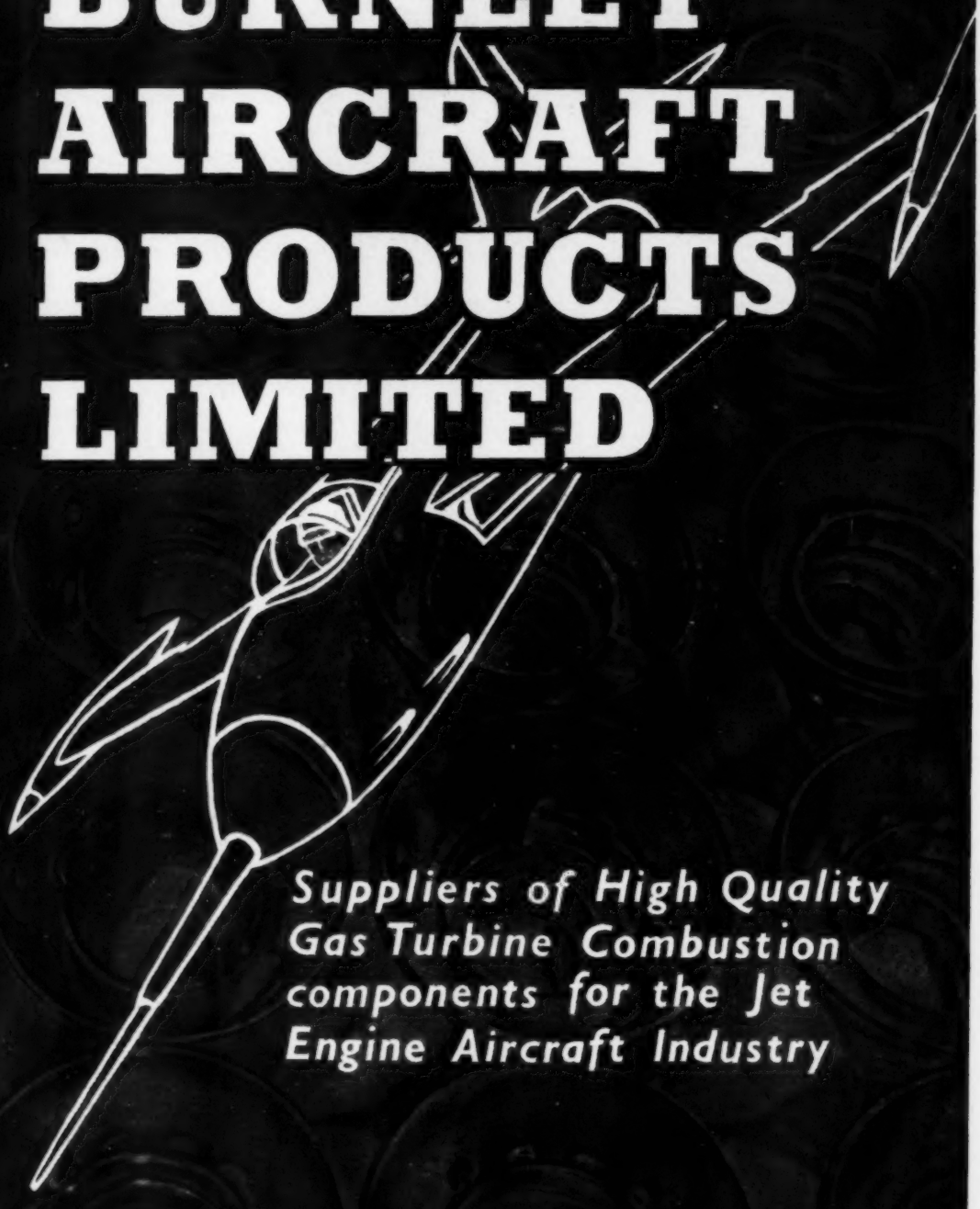

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A WORLD OF VIBRATION

Vibration technology is a comparatively new development in the field of environmental engineering. Its applications in measuring metallurgical stresses and strains, in simulating fatigue to destruction point, are fairly well-known, but even the present scope is far wider than these. The potential is immense to a degree which possibly outreaches that of any other applied science. It is even possible that there is much to be rediscovered, for the histories and mythologies of ancient civilizations abound in references to physical motion achieved through sound vibrations. The destruction of the walls of Jericho is an example; and it has been suggested that the Pyramids' vast masonry was elevated by similar means. But fascinating and perhaps revealing as that line of inquiry may be, this report will deal principally with the immediately practical uses of vibration testing.

From eyes to motor cars is an apt and related part of the applications range. Taking the first and uncomfortably picturesque example, an incidence of severe headaches and impaired vision suffered by transport drivers led to tests with vibration equipment. These showed that through vibration on certain road surfaces, the drivers' eyes were being literally bounced back and forth in their sockets.

MOTOR VEHICLE INDUSTRY

Car bodies and their attachments are subject to mechanical and other vibrations transmitted through suspension systems. What with wear and tear and varying concern for maintenance, the noises which can result are an age-old problem at the service station. The drumming heard by the owner 'under the back seat somewhere' is usually non-existent in normal workshop testing; out on the road it's audible but locating it is a tedious and uneconomic guessing game.

Yet further complications arise out of the fact that the vibration source may be far removed from the apparently offending component or structure.

We have a compact generator/oscillator/power amplifier combination by which all the running vibrations can be simulated *in the workshop* and the noise source accurately and quickly located. Similar equipment is used by car manufacturers so that vibrations can be compensated or designed out.

ROAD CONSTRUCTION

Roads, too, can be investigated with vibration equipment. An applied vibration is picked up at a distance, on an oscilloscope. The signal time and strength factors vary according to the nature and thickness of the surface and subgrade materials. By these readings it can be determined whether or not the construction is according to specification. Periodic tests will reveal the extent of any deterioration. In research, the behaviour of roads under various traffic conditions can be established and the information used in framing specifications for new roadworks.

AIRCRAFT INDUSTRY

In the aircraft industry, vibration testing has long been a vitally important technique. Bearing in mind the possible outcome of the failure of quite small components, vibration problems in land vehicles and structures pale into comparative insignificance. Goodmans equipment is widely used to test dynamic models . . . even whole aircraft . . . and on the multiplicity of instruments and electronic apparatus.

The tremendous power and complexity of rocket-propelled vehicles set still more exacting requirements and for these Goodmans are producing special generators.

OTHER APPLICATIONS

The miscellany of these is far too extensive to catalogue here, but the following will serve to demonstrate the scope.

In fatigue testing, vibration generators provide wide range and prolonged consistency.

Chemical and bio-chemical research are served by our smallest generator, the V47, in mixing, emulsifying and the measurement of interface potentials. It has been used also to simulate nerve signals and to assess vibration effect on living tissue. Experiments show that physical vibration and 'white noise' have anaesthetic properties.

Vibration equipment is used in the rubber, plastic and textile industries, as an aid in establishing the materials' mechanical properties.

Experiments in the machine tool industry have shown that small and carefully controlled vibrations can, in fact, improve stock removal, surface finish and minimize the effect of certain operations upon molecular structure.

This is inherently a world of movement. Everything vibrates within itself and often as an entity. These forces can be observed, reproduced, supplemented. There must therefore be many functions for our vibration equipment which even we can only guess at . . . and even more as yet unthought of. Name your problem; consider what may be done better, faster, more economically . . . what may be done perhaps for the first time, with the help of vibration equipment. It's more than likely that the means to the end is ready-made.

Goodmans electro-mechanical vibration generators, the largest range in Europe, comprise:

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390A	17 lb
790	35 lb
8/600 Mk.II	300 lb
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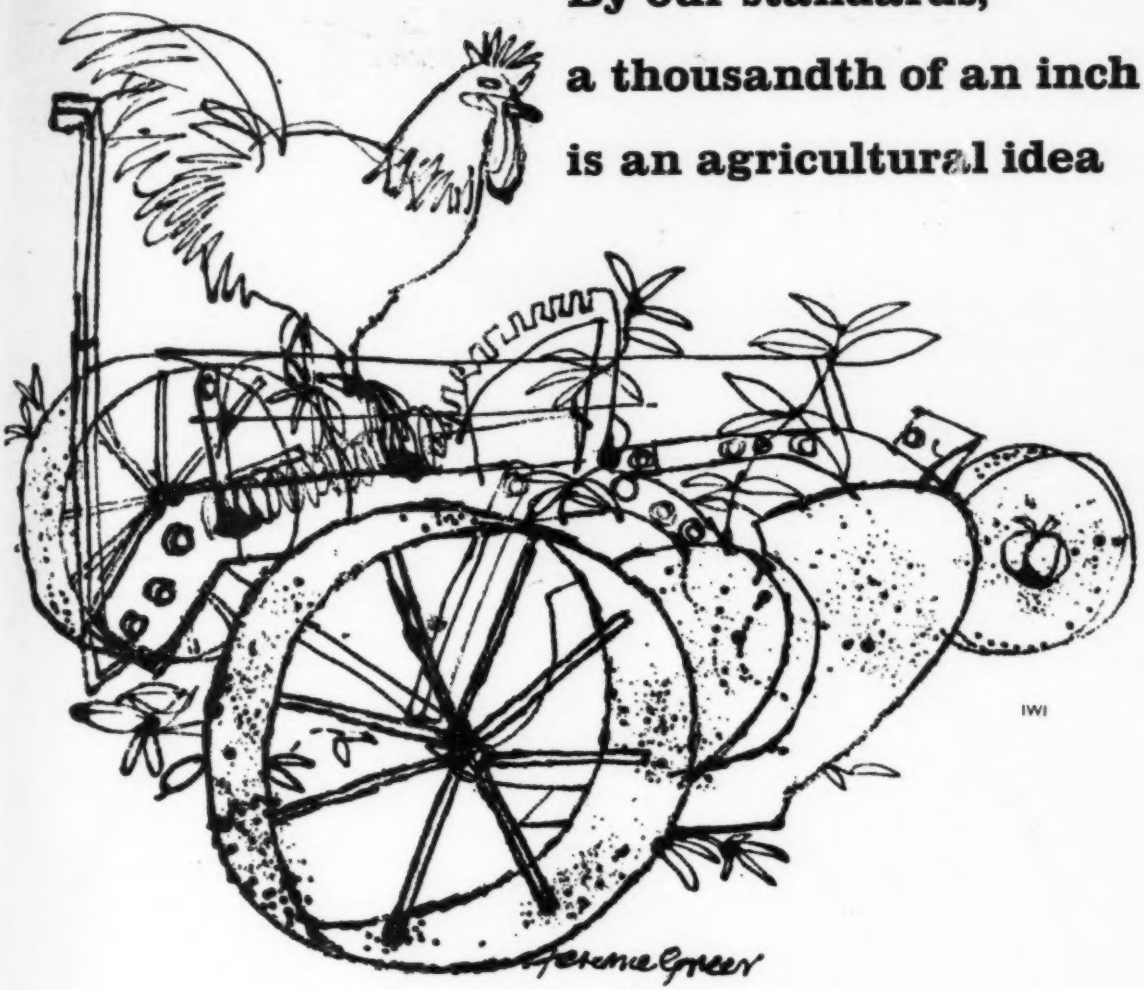
By our standards, a thousandth of an inch is an agricultural idea



You know about the man who was asked how big a 'thou' was? 'Very, very small' he said. He was asked how many there were in an inch. 'Millions of them' he said.

In this unusual factory of ours—unique in Europe, we suppose—we don't think of a 'thou' as at all small. We have had to train ourselves to take a tolerance of half a tenth in our stride, and to use on our production inspection-line a machine that will measure out-of-roundness of the order of one millionth of an inch.

But then we are in production with instruments the like of which the world has never seen before. We produce (in partnership with Minneapolis Honeywell) Inertial Quality Gyroscopes so accurate that they precess less than half a degree *per day*, so sensitive that you can use them for finding true North to within a few minutes of arc. Small wonder that we do 'sand'-blasting with bicarbonate of soda, and that a speck of dust is a calamity.

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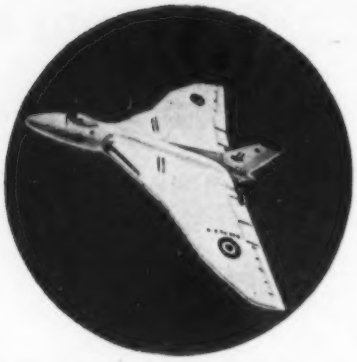

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No 2733 VOLUME 80 THURSDAY 27 JULY 1961

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On the Scent

AGAINST competition described by Lord Caldecote, executive director (guided weapons) of the British Aircraft Corporation, as "very, very fierce," the Bloodhound 2 anti-aircraft missile has nosed its way into the air forces of Sweden and Switzerland. On the same scent for orders totalling perhaps forty million pounds were the Boeing Bomarc (Sweden) and the Raytheon Hawk (Switzerland); so the Bristol, Ferranti, AEI and Bristol Siddeley teams are to be applauded for bringing about one of the most encouraging items of export news for many years. Especially gratifying, having regard to past—and continuing—criticisms of the Ministry of Aviation in respect of the export trade, is Lord Caldecote's emphasis that development of Bloodhound has been a real team effort between the aircraft industry and the MoA.

Formerly it has been bargain-basement prices which have generally won missile orders. Co-operation, sheer merit and environmental suitability are now seen as the formula which can command true success.

Bilaterals and the Board

WHEN Parliament established the Air Transport Licensing Board it ignored the question of the Board's position in regard to traffic rights and inter-governmental agreements—the so-called bilaterals. The matter was never even debated, and was only once mentioned by the Minister, Mr Sandys. He said: "I think it will be agreed that it would not be right for an outside body such as a licensing board to put the Government under an obligation to open negotiations with foreign governments if they do not think it wise and opportune to do so."

Traffic rights were specifically excluded from the matters that the Board was required "to consider in particular" when granting licences. As a gesture, the Minister allowed that he and the Board "should from time to time consult together" about traffic rights; but in the same breath he assumed the draconian power to direct the Board to reject any application that he, the omnipotent Minister, thought might involve him in "inexpedient" negotiations.

In reviewing the proposed legislation before it went through Parliament we said (February 26, 1960): "Traffic rights are an integral part of air transport, and the regulatory authority should have explicit powers to initiate policy and to interpret agreements." A few weeks later, on May 13, we expressed the view that a board without the power at least to initiate policy in regard to traffic rights, which are the very lifeblood of air commerce, was bound to be enfeebled. Those fears are now being realized.

Throughout the big European routes case, now drawing to a close, the Board has been in some difficulty. It has heard BEA and BOAC insisting—in their general cases and route by route—that the consequence of licensing an independent in parallel with the corporations would be that they would have to give up some of their bilaterally predetermined share of the traffic.

British United maintained (quite reasonably, since the Minister never exercised his power to direct the Board to reject BUA's applications) that bilaterals have nothing to do with the Board. According to the strict letter of the law this is true; but the Board decided to allow evidence on bilaterals, and it was right to do so.

We hope that the Board will not refuse an application solely on the grounds that it will upset bilateral agreements. A tougher Ministry line here is long overdue, as is discussed in a note on page 131 of this issue.

FROM ALL QUARTERS

US Supersonic Airliner

ISSUED last Monday by the US Federal Aviation Agency, National Aeronautics and Space Administration and Department of Defense, a 50-page report entitled *Commercial Supersonic Transport Aircraft* is a valuable distillation of information gathered from a wide range of industrial and government sources. Nobody seems to have the courage to depart from the party line that the correct cruise Mach number is 3; in fact, many appear to take this for granted, before considering the other major variables.

It could well be that M3 is right. The US may have, as the report claims, "a unique capability for developing a supersonic transport," although the article on pp 109-112 of this issue suggests that Soviet supersonic experience is also of immense breadth and depth. And M3 is not the unanimous choice of the customers.

In general, the final submissions by major manufacturers are designed to carry 100 to 150 passengers over a 3,500 n.m. stage while cruising at some 2,000 m.p.h. (M3) at 70,000ft; span and length average about 100ft and 200ft respectively. There is wide agreement on the need to develop a completely new and uninhibited powerplant design, and "some form of turbofan" is almost unanimously asked for by the airframe firms. Variable-geometry wing designs are clearly being seriously considered, and major research programmes are investigating sonic boom problems. During the coming financial year (FY62, which began on July 1) NASA is devoting about $8.5m (£3.05m) to SST research, and the FAA about $12m (£4.29m). The report estimates that production aircraft will be priced at between $12.6m and $20m, and that the market between the years 1968 and 1975 (excluding the Communist countries) should be between 75 and 450 aircraft.

Marine-aircraft Sport

THE SEAPLANE CLUB hopes to use Lee-on-Solent as an operating base when it acquires its first aircraft. Negotiations with the Admiralty are progressing well, Air Cdre G. J. C. Paul, secretary of the club, reports, and it is hoped that the club will have a joint associate-membership scheme with the Lee-on-Solent sailing club. A pair of suitable floats has been located at a cost of £500 and, as already reported, Mr Norman Jones has promised the club a Tiger Moth. An application for a loan of £1,100 has been made to the Private Flying Loan Fund recently set up by the SBAC and Shell Mex and BP.

Sudanese Jet Provosts

AN order has been placed with Hunting Aircraft Ltd (a company of the British Aircraft Corporation) for the supply of a number of Jet Provosts and spares for the Sudan Air Force. They are to be fitted with machine guns and will be capable of carrying rockets and bombs.

The Sudan Air Force is already an experienced operator of Hunting machines, having Pembrokes and piston-engined Provosts already in service. SAF pilots have done courses on the Bristol Siddeley Viper-powered Jet Provost with the RAF at No 2 Flying Training School, Syerston, Notts.

Business Aircraft Users in Business

THE Business Aircraft Users' Association is now represented on the Ministry of Aviation's Standing Joint Committee on Private and Club Flying and Gliding. The Association has written to over 260 prospective members—companies who have aircraft registered in their name—in its first large-scale recruiting campaign, and has outlined its plans for the immediate future. These facts emerged from a press conference held on the occasion of the Association's first general meeting in London on July 21.

It was reported on this occasion that the Association now had a total of 44 members, of which 20 were full members and 24 associate members. The flying and legislation committee had decided that the most pressing problems facing business aviation were those of airfields, the use of airspace, and Customs facilities, and proposed that the three items should be tackled in that order. This would be followed by studies of radio facilities and meteorological services. The main concentration of effort on the airfields problem had been directed towards the reopening of Croydon for business aviation.

DISCUSSING SEACAT production at Queens Island, Belfast, recently were (right to left) Sir Steuart Crichton Mitchell, MoA Controller of Guided Weapons and Electronics; Mr K. Teale, Short's chief production engineer on Seacat; Mr J. E. Serby, Director-General, Guided Weapons, MoA; and Mr H. G. Conway, Short's joint deputy managing director and chief engineer

STUDYING A CONWAY by-pass reverser and nozzle at the Derby works of Rolls-Royce Ltd are members of a 30-strong party from the Commonwealth Advisory Committee on Defence Science which toured the company's facilities on July 18 and 19. The visitors, among whom were delegates from Britain, Canada, Australia, New Zealand, Rhodesia, Malaya, Nyasaland, India and Pakistan, heard talks on rocket engines, multi-fuel piston engines, VTOL powerplants and other developments

The Association's two representatives on the Standing Joint Committee are Mr M. A. H. Bellhouse (of the Pressed Steel Co) and the chief executive, Mr R. R. Stephenson, formerly aviation secretary of the Royal Aero Club. Chairman of the BAUA flying and legislation committee is Mr T. A. Vigors, of Vigors Aviation.

News from Sikorsky

AN accompanying artist's impression depicts the probable appearance of a high-speed helicopter using essentially the same propulsion system (two GE T58s) and rotor system as the S-61 family. The US Army Transportation Research Command at Ft Eustis signed a contract with Sikorsky for a design study for a helicopter having a speed of 200 m.p.h. and ferry range of 1,840 miles, while retaining a "conventional single main rotor configuration" and satisfactory handling characteristics. Costs were shared between the Army and manufacturer.

Head of the project was Evan Fradenburgh, who writes: "Analysis of the design shows that these objectives can be met, and in some cases substantially exceeded. Ferry range achieved is 2,400 miles; top speed without payload is 224 m.p.h.; and payload at the design cruise speed of 201 m.p.h. is 4,000lb for a range of 150 miles. Payload may be increased to 7,000lb by cutting cruise speed to 173 m.p.h.—which is still considerably higher than that of current helicopters." These performance predictions are based upon much improved research methods, particularly into the calculation of blade performance and vibratory stress, rotor performance in

HOT HELICOPTER design study by Sikorsky, described in a news-item in these pages, uses dynamic components of the S-61 but has a maximum speed of 224 m.p.h. The low-drag fuselage seats up to 20 troops, houses the retracted landing gear, and carries an aeroplane-type tail unit

HUMMINGBIRD: This is the name given to the jet VTOL aircraft (right) being built for the US Army Transportation Research Command by Lockheed's Georgia Division. (See news-item, "Lockheed VTOL")

flight regimes beyond those in which existing theory applies and new methods of determining flight characteristics.

Other news from Stratford, Connecticut, is that the first H-37B (S-56) has been delivered to the US Army under a $3.5m contract placed last year for the conversion to this new standard of 30 H-37As, and the recent conclusion of a $3.1m contract for the conversion of a further 30. The H-37B has a Lear autostabilization system, crash-resistant fuel cells, more rapidly retracting landing gear and revised nose and side cargo doors for loading and unloading in hovering flight just off the ground.

On June 21 the S-61L (airline S-61) was awarded its FAA Type Inspection Authorization, the last stage before the FAA flight evaluation leading to certification. The S-61L already has a Provisional Type Certificate, and was the first twin-turbine helicopter to be so qualified.

Lockheed VTOL

AFTER extensively studying turboprop aircraft combining tilting wings with large-deflection flaps, Lockheed's Georgia Division have won a US Army research contract for a machine using the ejector principle. Known as the Hummingbird, the first experimental version will be similar to the artist's impression above.

Two lightweight turbojets provide all the power for vertical lift and propulsion. The type chosen may not be specified, but the GE J85 or P & WA J60 appear likely. For VTOL a system of valves and large-diameter pipes of minimum length diverts the entire jet from each engine to annular blowing slits surrounding the venturi interiors of two large lift-ducts occupying the mid-fuselage. These ducts are essentially simple tubes, with intakes at the top beneath the series of transverse guide vanes and shut-off doors, and propulsive nozzles at the bottom. Air is entrained by the high-velocity, hot-gas sheet ejected from the annular slit. The total airflow for lift is several times the engine mass flow, and mean lift-jet velocity is substantially lower.

As a result, hovering efficiency is very much better than the best attainable by direct lift-jet engines, and it may be fair to claim some advantage in reduced noise and ground erosion (particularly erosion of unprepared surfaces). All hot-gas supply systems are fully duplicated, so that in the event of engine failure the remaining turbojet can feed both lift-ducts. In forward flight the engines function as simple turbojets, and high forward speeds will be attainable. The chief problems concern perfection of the ejector slot and duct, and of the programmed control of the diverted valves in transitions to and from wing-supported flight. The US Army Transportation Research Command will evaluate the aircraft at Ft Eustis, Virginia.

IN BRIEF

Number of people employed in "aircraft manufacturing and repairing" in Britain during April was 297,700, an increase of 1,200 over the March figure.

Aircraft Operating Co of South Africa have secured contracts for aerial photography of the whole of Swaziland and Basutoland and 30,000 sq miles of Bechuanaland.

A Grumman Gulfstream has been bought by the Government of Nigeria. It will be used by the Prime Minister, Alhaji Sir Abubakar Tafawa Balewa, and members of his Government.

The Garrett Corp (9851 Sepulveda Boulevard, Los Angeles 45, Cal) have available reprints of a paper which outlines the proprietary rights of manufacturers in defence contracts under US law.

Five swing-tail Canadair CL-44D freighters have been ordered for the Royal Canadian Air Force, which already has nine out of 12 CL-44s in service with conventional side-door loading.

Over 1,300 model aircraft—made by Mr Peter Farrar of Torquay—are being dispayed in London between August 28 and September 9 at Selfridge's, Oxford Street, W1. They are all built to the same scale of 1 : 72.

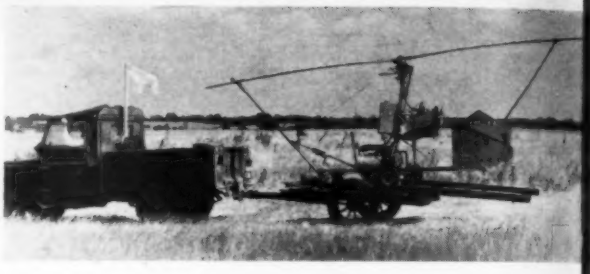
The first Cessna 185 Skywagon to arrive in this country has been assembled by Airwork Services Ltd at Panshanger and test-flown by their Cessna manager, Mr R. Potgieter. It will take part in the Business and Touring Aircraft Competition next weekend.

Mr William Harpley, deputy general manager of the English Electric Preston works and Samlesbury flight sheds, died suddenly at his home recently. Aged 60, he had been deputy general manager for the past two years; previously he was aircraft manager and before that works manager.

Wingfoot Lighter-than-Air Society, the American association of airship and balloon enthusiasts with headquarters at Akron, Ohio, has appointed an assistant membership chairman for the United Kingdom—Mr H. R. Bantock, 81 Queens Road, Buckhurst Hill, Essex. The society has some 50 members in Britain and the Commonwealth.

HI HYSTERESIS: An experimental plastics undercarriage is fitted to the Malmo Flygindustri MFI-10 Vipan at Bulltofta Airport, Malmo, Sweden. The legs are described as consisting of "wedge-shaped, rubber-covered Fiberglas reinforced plastic plates, bonded to the undercarriage spring and internally attached to steel fittings in the fuselage." Better damping and less bouncing on rough ground are claimed, together with low stiffness and better resistance to very low winter temperatures

Above, the Napier-modified Gyro-Copter is demonstrated at low level by company test pilot S. J. Bartlam. Above right, close-up of the aircraft, showing flexible drive from engine to rotor spin-up gear. Right, the Gyro-Copter aboard its simple transporter



"Flight" photographs

Agricultural Gyro-Copter

DEMONSTRATED at Luton Airport last week was the prototype of an agricultural version of the Bensen B-8M Gyro-Copter which is being developed jointly by D. Napier & Son Ltd and Pan Britannica Industries Ltd. Regarded by its sponsors as a spraying tool which flies rather than an aircraft carrying a spray-boom, the machine is stated to be the first step towards a radio-controlled spraying vehicle.

The autogyro formula was chosen to give the best combination of advantages of both rotary-wing aircraft (low and slow flying) and fixed-wing machines (ease of maintenance and piloting). Simplicity, manœuvrability, all-round vision and ease of transport are other main advantages envisaged for the Gyro-Copter in its agricultural rôle. A feature of the operation of the machine will be the use of a small payload per flight, combined with quick, on-the-spot refilling. It is estimated that the spraying cost should be approximately half that of an agricultural Tiger Moth, and that the fixed-wing aircraft's "dead time" in turning between spraying runs should also be halved.

Napier's adaptation of the original Bensen Gyro-Copter comprises the addition of spray equipment, a spin-up device for accelerating the rotor to about 300 r.p.m. before take-off, and a new propeller constructed by the Airscrew Co & Jicwood Ltd. The spin-up device includes a gearbox immediately beneath the rotor hub which is connected via a flexible drive to a friction wheel on the McCulloch 4318E engine. A similar friction drive is used for the spray pump.

Having been evaluated as an aircraft by Napier, the modified Gyro-Copter is now being handed over to PBI for operational evaluation, including practical spraying in the field and studies of operating costs. It is envisaged that a developed version might be put into production in this country in perhaps 18 months' time at a selling price between £3,000 and £4,000. A licence agreement with Bensen Aircraft Corp is being negotiated.

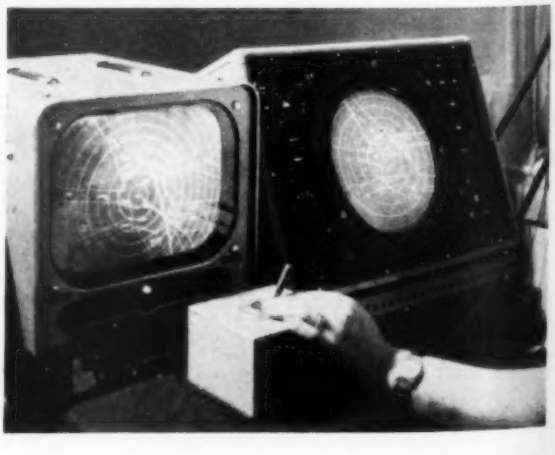
VDF TRIANGULATION HELPS PRIMARY RADAR

DURING a period of about seven weeks Standard Telephones and Cables Ltd and the MoA ATC Experimental Centre at London Heathrow have conducted a series of trials using a CADF network and PVT.2 triangulation system to identify radar returns from aircraft shown by one of the radars on the site. The PVT.2 display consisting of a bright television picture bearing a variety of maps or grids shows the bearing lines derived by land-line from a group of remotely located CADF stations. The operator has a joy-stick control with which he can steer a dot or other symbol on the television display to mark the point of intersection of the bearing lines. The fix thus established from a VHF communications transmission from the aircraft is transferred directly onto the same location on the primary radar display, where it identifies the appropriate radar return.

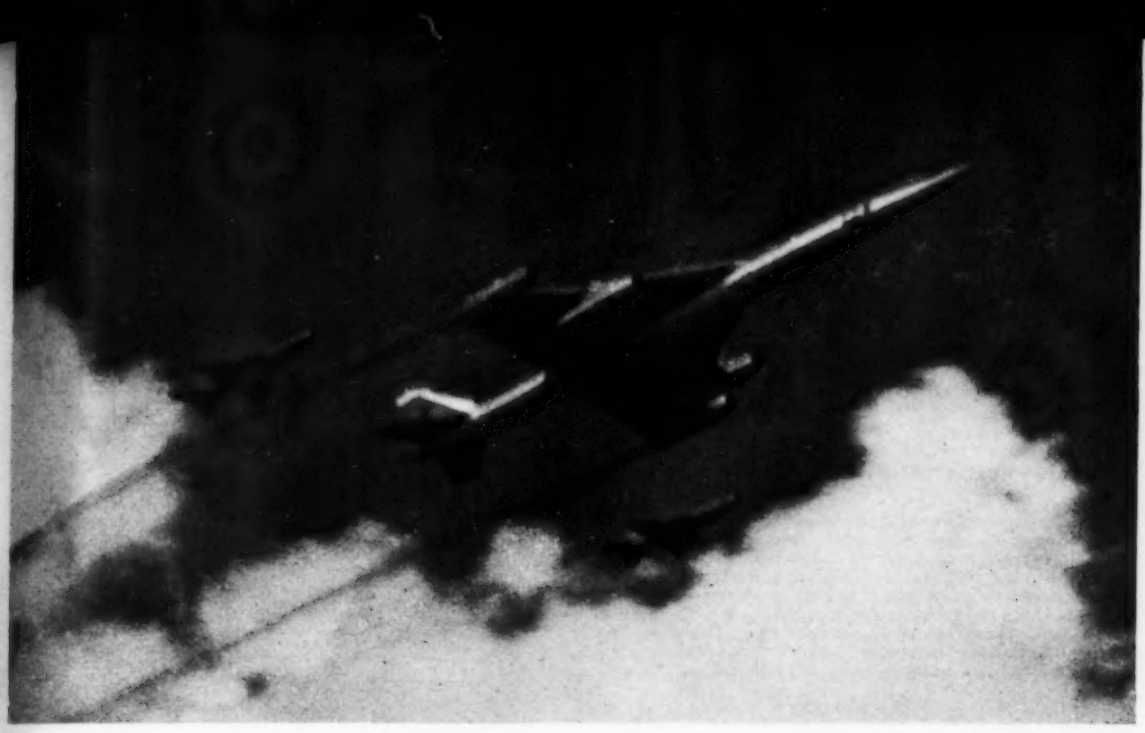
The experiment was conducted by the RAF element at Heathrow with the co-operation of MoA, who provided land-line and inter-console marking facilities, the use of the S.14 radar and accommodation. One mobile CADF station in an Aircon container was set up at Heathrow, in a relatively poor site, and the signal from another CADF on STC ground at Frogmore Hall, Herts, was transmitted as a DC voltage over land-lines. This gave a fairly narrow aperture for fixing and only the minimum number of stations for the purpose. The PVT.2 installation can combine up to 12 bearing signals and superimpose a variety of map or grid backgrounds.

The RAF already uses extensive triangulation networks and runs the emergency fixing service in the UK. With their requirement for fixing of aircraft in more or less random positions, as opposed to airways traffic, VDF working offers very considerable advantages. The PVT.2 network at London was giving fixing accuracies of about one mile at good angles of cut and, although the definition of the bearing lines was not very fine, the human operator could, with practice, position the marker very accurately. Provided that aircraft returns were reasonably separated, as they should be in any airways traffic situation, identification was effective and operation was quick and simple. A variety of symbols can be used, according to the capability of the inter-console marking system.

The next step appears to be to provide some means whereby the fixing and transfer operations are automatically completed. In addition, height reporting by voice might provide the same service as is at present expected from secondary radar, but without additional equipment in the aircraft.



Steering the dot on the PVT.2 television screen to mark the VDF fix. The dot identifies a radar return on the primary radar



RUSSIAN REVELATIONS

New Aircraft Seen at Tushino on July 9

By the TECHNICAL EDITOR

IT is fortunate that the leaders of the Soviet Union sometimes decide to display their latest military aircraft in a fly-past; for, if they did not, the non-Communist world could eventually become misled by the unceasing stream of code-names, unofficial designations and illustrations of aircraft which may or may not exist. Things were getting pretty out of hand when, on July 9, the first major show of its type for five years was staged at Tushino, near Moscow.

During the past two years, Russian spokesmen have emphasized their country's increasing reliance upon rocket weapons. Many Americans seem to have taken this to mean that the Soviet Union had ceased development of military aircraft, and now appear to regard the recent display as in some way indicating that "the West" has been terribly misled.

Photographs at Tushino were officially restricted to those taken by Soviet cameramen; but one or two Western shutters were clicked —and to some effect, as recent issues of *Flight* testify. It is now possible for this journal to attempt to assess what the Russians showed. As we did in our corresponding review five years ago ("Red Round Up," August 3, 1956), we have prepared a three-view drawing of each of the more important new types. Our artists must have become heartily sick of being instructed to "draw it according to the evidence, not the way you think it ought to be"; the same type of reasoning has been attempted in the text, and the Editor's views on jumping to conclusions were voiced in a leading article last week.

Prior to July 9, the only information disclosed by the Russians concerning their latest types of aircraft were the submissions made for record purposes to the FAI. In chronological order these are:—

July 1959, RV aircraft, with mid-mounted swept wing and powered by two 4,000kg (8,818lb) Type 37V turbojets. Load of 1,000kg lifted to 20,456m and 2,000kg to 20,174m.

July 14, 1959, T-431 aircraft, powered by 9,000kg (19,840lb) turbojet, flown by Vladimir Ilyushin (son of the famous designer). World-record altitude of 28,852m.

September 16, 1959, 201-M aircraft, powered by four 13,000kg (28,660lb) turbojets, flown by Nikolai Goryanov, Anatoli Lipko and crew of five. Payload of 10,000kg lifted to 15,317m. On October 29 the same aircraft, flown by Boris Stepanov, Boris Yumachev and crew of five, lifted loads of up to 55,000kg to 13,121m.

October 30, 1959, 103-M aircraft, powered by four 13,000kg (28,660lb) D-15 turbojets, flown by Anatoli Lipko, Yuri Yumachev and crew of six. Payload of 27,000kg flown at high speed round 1,000km circuit.

October 31, 1959, E-66 aircraft, powered by 5,950kg (13,117lb) RS7F turbojet, flown by Col Georgeii Mossolov. World-record speed of 2,388km/hr (1,484 m.p.h.).

May 28, 1960, T-405 aircraft, flown by Boris Adrianov. Speed of 2,091 km/hr (1,299.24 m.p.h.) over 100km circuit.

It is an interesting diversion to attempt to see which of these designations best fits the hardware shown for the first time at Tushino earlier this month. In any case, in the absence of knowing what the aircraft are called, it is convenient to take the display in the order in which it was presented, prefacing our comments with extracts from the eulogistic Russian commentary.

"*The fly-past of military aircraft begins. It is led by an immense rocket-carrying aircraft piloted by Lt Col Straptsov . . . Each rocket is the size of a fighter . . . and can hit any ground target at a great distance.*"

This was a Bear (a Tupolev design said to be designated Tu-20) which, like its counterpart the B-52, is being revitalized by the addition of large stand-off missiles. The Lt Colonel's aircraft bore the number "40," and has a new nose apparently wholly occupied by radar. The missile is carried half-submerged on the centreline, and the example seen had a white nose but was otherwise entirely fluorescent orange. The weapon has a mid-high swept wing, small swept tailplane and folding ventral fin; propulsion is either by a rocket or turbojet with a submerged intake, and range should be at least 500 miles.

"*The Guards Air Force units . . . fly in sections of three, and they all carry orange-coloured rockets.*"

There were five such sections, the aircraft being Tu-16 Badgers. The missiles they carried are reminiscent of Hound Dog, and are powered by a turbojet (possibly ramjet) underslung at the rear. This weapon was pictured on p. 71 of last week's issue; it appears to have a range of about 300 miles (US estimates are lower).

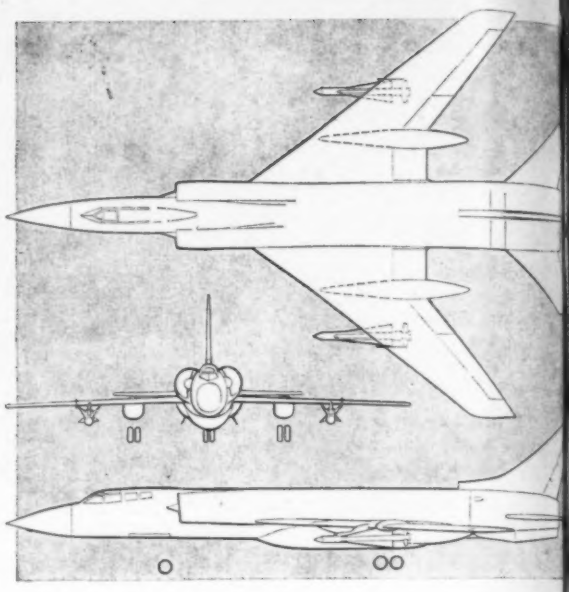
"*Super-heavy supersonic aircraft are approaching . . armed with rockets. The turbines are at the tail . . . even this fly-past at the slowest speed is very fast indeed.*"

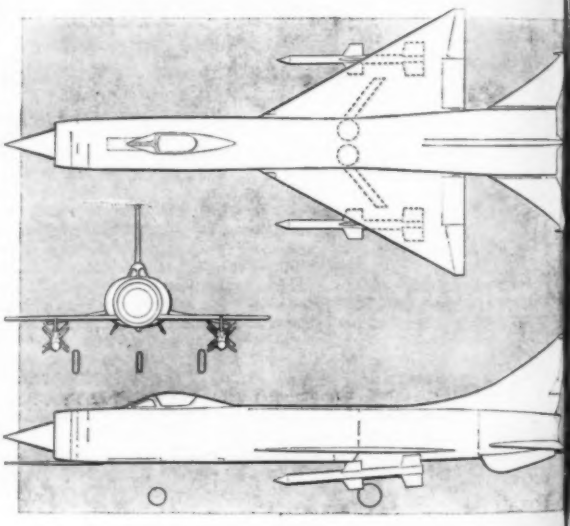
This was the greatest of the revelations. The aircraft is roughly in the class of the B-58, and Senator Stuart Symington—no slouch in matters aeronautical—is quoted as saying, "Its lines are so fine that those who took the photograph call it Beauty." Whatever code-name may be hung on it, and there is no clue to its designer —apart from the fact that Tupolev was responsible for the preceding machines, and that the new aircraft bears some hall-marks of his bureau—this aeroplane is a superb piece of engineering. Design Mach number is probably of the order of 2 to 2.2. Area-ruled principally in side elevation, like the B-70, this lovely aeroplane may at present be the fastest of its size in the world. Engines have not previously been mounted in quite such a manner, and in the absence of adequate evidence the front view of our drawing must be taken as provisional (we took a long look at two alternatives: pylon-mounted pods and a single box with the fin on top).

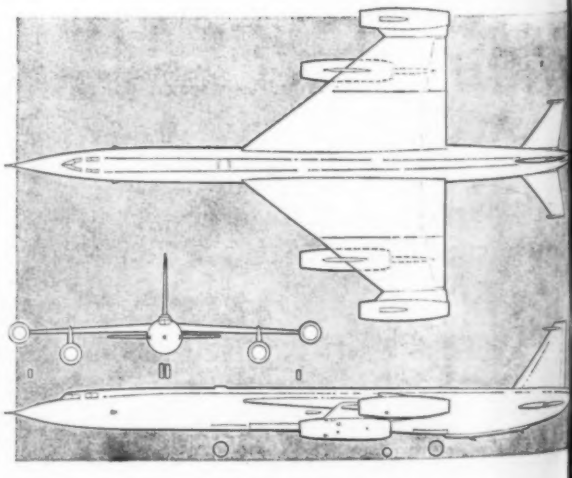
At Tushino, three sections of three were preceded by a single example—possibly a development aircraft, bearing the number "24"—which is the subject of our drawing. Not only did it have what could be a retractable refuelling probe above the nose, but

In the heading picture: Bounder, escorted by fighters

A photograph of this Yak-25(?) version has not been published elsewhere. It is an all-weather fighter, apparently with a new radar fire-control system and large guided weapons outboard of the engines







RUSSIAN REVELATIONS . . .

it carried a large missile—a point which does not appear to have been reported elsewhere. Admittedly this machine is clearly not intended to reach much over M1 at low levels; but it is eloquent testimony to the effectiveness of Western anti-aircraft defence that so fast an aeroplane should not be able to use free-falling bombs. And it is relevant to point out that no such missile has been designed for the B-58. The missile has a small delta wing, a large underfin and a blunt tail like Blue Steel; but it is smaller than the British weapon, and probably has a range of some 200 miles at high supersonic speed.

Like the B-58, the crew of this bomber is probably three, accommodated in a series of cockpits which lead into a full-length dorsal spine. Again like the B-58, M2 performance is still inadequate for tail armament to be dispensed with, and there is a rearwards-looking radar surmounting a remotely controlled gun barbette. The nine presumed production aircraft have a black area around the underside of the nose some 11ft in length, suggesting a bombing radar similar to that of the B-58. The discontinuity in the undersurface of the forward fuselage probably arises from an additional forwards-looking radar, and it would be logical to suppose that extensive electronic countermeasures are carried. Main gears fold into Tu-104-type nacelles, the distance between the engine intakes and nozzles is around 30ft, the slab tailplanes are cut back at approximately the Mach angle and there is ample evidence to suggest that the radius of action is not less than 1,000 n.m., including a supersonic dash.

"*Now flights of supersonic fighters, led by Maj-Gen of the Air Force Astakhov, are approaching . . . under the wings of these aircraft are air-to-air rockets.*"

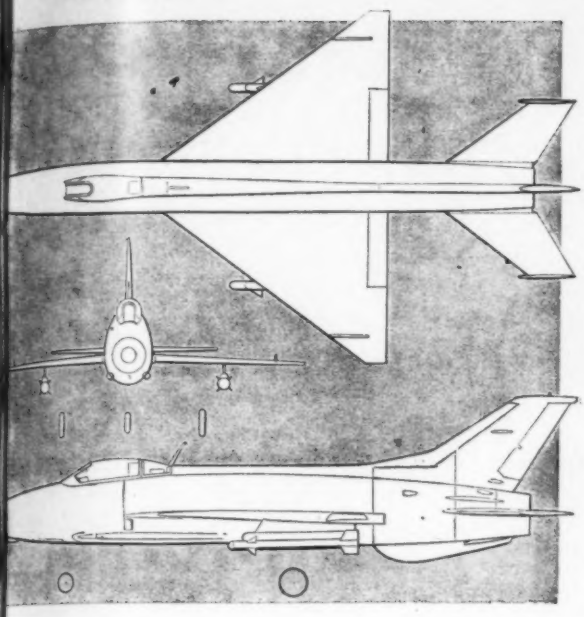
At this point we must turn to the delta-winged fighters and admit our ignorance. Before July 9 we had heard much of the Mig-21 "Faceplate," the very similar "Fitter," and the Sukhoi Su-15 "Fishpot" and Su-16 "Fishbed." Immediately prior to Tushino it was intimated that there were three distinct types of Sukhoi delta, and both Sukhoi and Mikoyan (leader of the Mig bureau) were named as responsible for "new rocket-carrying and rocket-powered aircraft." But it is difficult to identify any one type.

This first group, led by Astakhov, appear to be standard equipment for day fighter and attack duties. The delta wing has extended leading-edge roots and squared-off tips, and the swept horizontal tail carries forwards-projecting tubes at the tips—possibly a mass-balancing arrangement, and a characteristic Russian feature. The single turbojet is fed through a direct pitot nose intake and has an afterburner and variable nozzle. The canopy and windscreen appear to be moulded in a single upward-hinging unit, giving good visibility at high angles of attack, faired into a dorsal spine leading back to the fin. Another Russian characteristic is the ventral fin, in this case a large single surface. Stores pylons are located on the centreline and beneath each wing outboard of the main gear. The pylons can handle various combinations of bombs and guided weapons, the latter being an air-to-air missile extraordinarily similar in appearance to Sidewinder.

"*A new wave of fighters is sweeping towards us: these are supersonic multi-purpose aircraft.*"

The sky became full of advanced developments of the Yak-25 (Flashlight), which has been in service in great numbers for six years. The basic design has proved itself amenable to a remarkable amount of development, and three basic variants were identified at Tushino. The first is essentially similar to the "Flashlight C," with a glazed nose ahead of the navigator and a single cockpit for the pilot. Superficially evident changes indicate improvements to internal systems, and the engines are fitted with long afterburners. The wing retains its profusion of kinks and dog-teeth, and the boxes for the outrigger wheels are extended forwards to form large probes inboard of the wing tips.

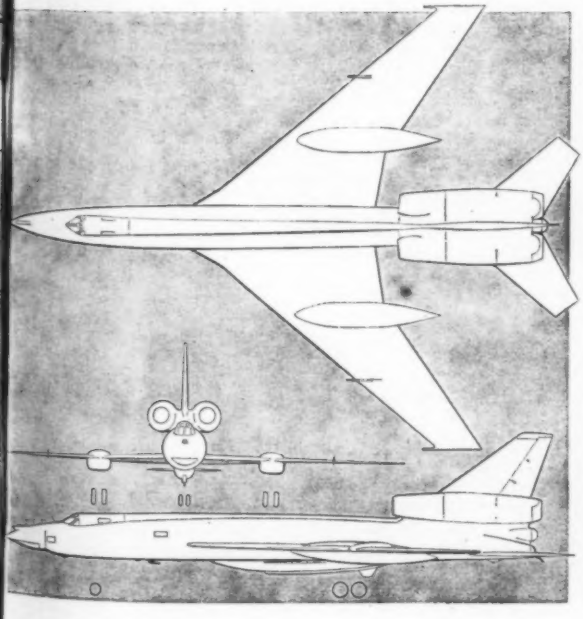
The other new version is a substantial redesign to serve a variety of defensive and offensive functions, probably with the FA ("frontal aviation," i.e., tactical forces). The chief difference lies in the



Left, reading downwards: the so-called Blinder, estimated to have a span and length of 53ft and 80ft and to weigh 65,000lb; the 2,000 m.p.h. Sukhoi, estimated to have a span and length of 28ft and 66ft 6in and a gross weight of 40,000lb; and Bounder, estimated to have a span and length of 90ft and 175ft, and a gross weight of 380,000lb

All drawings © Iliffe Transport Publications Ltd

Above is depicted one of the several types of day fighter/bomber which differ only in minor details and may be due to either Mikoyan or Sukhoi, the estimated span and length being 28ft and 50ft and the gross weight 27,000lb; below is the so-called Beauty, with an estimated span and length of 76ft and 105ft and gross weight of 150,000lb



powerplant installation; engine airflow is greater and the fatter nacelles terminate in an afterburner and variable nozzle of exceptional diameter. Each intake has a centrebody shaped like the fairings over the starter cartridges of a Canberra, suggesting that their primary function is non-aerodynamic. Gross weight is substantially increased, and the main-gear box is enlarged. A pitot static probe of fantastic size projects ahead of the nose, and some aircraft of this type are fitted with what appears to be a bombing radar immediately behind the nose gear. There is no certain evidence of guns.

"*Attention! Twin-turbine fighters are approaching the airfield; these too are dart-shaped, and fly at tremendous speed.*"

This aeroplane, which *Aviation Week* calls "Blinder" and ascribes to Yakovlev, is one of the most beautiful combat aircraft in the world and one of the unexpected revelations (as are the missiles which it carries). Although capable of tackling a wide range of roles, the two examples seen at Tushino appear to be equipped primarily as long-range intercepters. Pilot and navigator are seated in tandem, large AI radar is carried in the nose, the (multi-wheel?) main gears retract into "Russian" fairings, and there is obviously room for at least 3,000gal of fuel. Propulsion is provided by two afterburning turbojets, possibly of the RS7F variety; but this aeroplane is not capable of the speeds established by E-66, the design Mach number being of the order of two.

Beneath the fuselage is a fairing of exceptional size. Inspection suggests that this volume reduces drag, according to area rule, and it may be either a tank, weapons bay or (unlikely) special reconnaissance or radar equipment. There is no doubt that this aeroplane has the ability to lift very substantial loads in this location, but the wing carry-through structure makes an internal bay very shallow. The missiles under the wings may be employed in either an air-to-air or air-to-surface role. Their length is around 12ft 6in, the cruciforms of large delta wings and high-aspect-ratio tail controls are indexed in line, and the nose is a pure cone. No other Soviet weapon of such configuration has previously been seen.

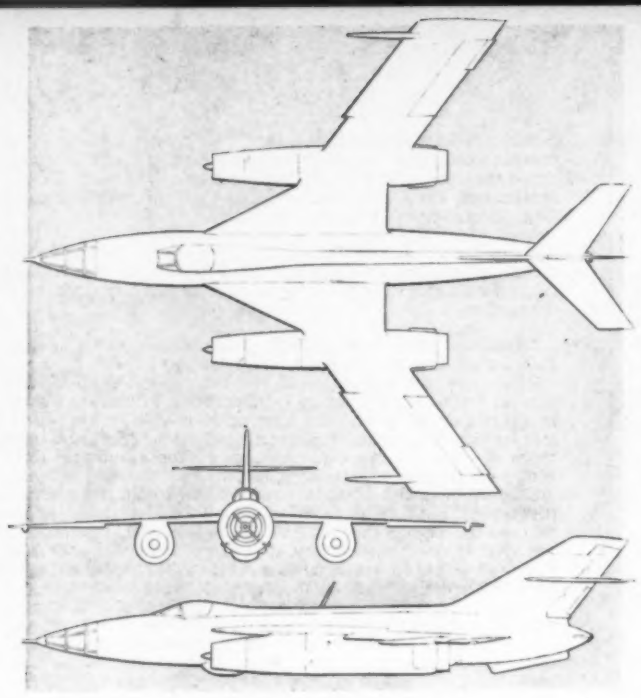
"*From Pavshino village a winged aircraft is approaching . . . tempestuous applause is drowned in the shattering noise of the powerful engines . . .*"

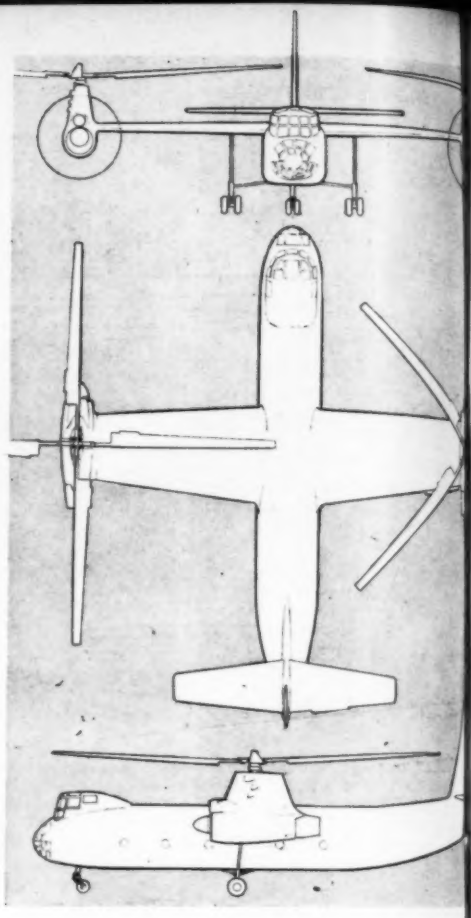
This was the mighty Bounder, which would have knocked us in the West for six had we not been introduced to it gently. According to US reports, the prototype was spotted two years ago, and poor-quality photographs of the aircraft were issued during the week preceding the Tushino display. This journal has described the design as being probably a bomber and possibly a transport; and it is certainly the largest and heaviest supersonic aeroplane yet to have flown. It seems to stem so logically from the "Bison" that it is not difficult to ascribe it tentatively to the design bureau of Myasishchev, whose name appears in the list of those responsible for the new types included in the display.

Altogether, Bounder is a tremendously impressive, if uninspired, design; if one wished to be unkind one could call it "a supersonic Tu-114." But this is not to suggest that its creation is not an aeronautical achievement of the first magnitude. One of its most puzzling features is that the propelling nozzles of the inboard engines have approximately twice the area of those on the wing tips. The intakes all appear to be identical, and one is led to suppose that the pylon-hung inboard engines are fitted with very large afterburners and variable nozzles. Photographs from the rear confirm this supposition, and indicate a cooling-air exit between the nozzle and nacelle. Bounder may well be either the 201-M or 103-M mentioned earlier, in which case the 28,660lb rating almost certainly applies to the dry engine. Aggregate thrust with full reheat on the inboards is probably some 140,000lb.

Nineteen photographs of Bounder escorted by its pair of fighters should have provided ample basis for determining overall dimensions. In fact, one estimate gave a fuselage length of 135ft and another illustration (that on page 109) yielded the startling figure of 240ft, but all the rest fell between 175ft and 190ft. Multi-wheel undercarriage units are carried fore and aft, and if tip-protection gears are

One of the all-weather fighters reminiscent of the so-called "Backfin" bomber and given the code-name of Blinder





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Above is the supersonic multi-purpose derivative of the Yak-25, with estimated span and length (without nose probe, not depicted in the drawing) of 47ft 6in and 60ft and gross weight of 40,000lb; to the right is the Kamov convertiplane, with estimated rotor diameter and fuselage length of 60ft and 75ft and a gross weight of 30,000lb

RUSSIAN REVELATIONS . . .

fitted they are in the large fairings between the outboard engines and ends of the wing proper. The latter carries conventional flaps and ailerons, and although relatively thin should contain some 10,000gal of fuel. There is probably similar tankage in the fuselage, which has a weapons bay amidships, pressurized cabin forwards, long dorsal spine and area-rule bulge aft of the wing. There is no evidence of armament. This is not a supersonic-cruise aeroplane, and its lift/drag ratio at maximum speed is not greater than five, so it is certainly not a supersonic airliner in its present form.

"*Another wonder plane is approaching; it is a hypersonic* (*Russian* mnogozvukovov) *interceptor . . .*"

Described by another Russian commentator as being "capable of more than three times the speed of sound," this flashing performer appears to be the handiwork of Sukhoi. Two examples were apparently displayed, differing in small details; and the actual aircraft drawn on page 110 was illustrated in our issue of July 6. As we commented at that time, this aircraft may well be the E-66, although it is undoubtedly twin-engined.

The intake centrebody suggests that the M3 claim is justified, the length of fuselage ahead of the wing is remarkable, and there are two ventral fins. One of the examples carried air-to-air guided weapons with the configuration shown in the drawing; and it is significant that the length of each missile is of the order of 15ft 6 in. It is this aircraft/missile combination which was described by one Russian commentator as being "armed to destroy any modern aircraft, whatever its speed and altitude." The U-2 really seems to have rankled.

"*A flying machine of unusual appearance appears, leaving behind a trail of orange-coloured flame . . .*"

With a shattering blast, this vanished vertically into the sky, but not before cameras had shown it to be almost identical to the jato-boosted fighter pictured last week (page 99). In fact, the only difference apart from the rocket appears to be an increase in the size of the dorsal spine aft of the canopy.

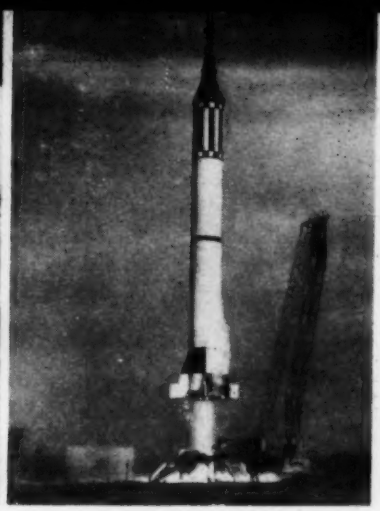
"*We now see the most powerful vertical take-off machine in the world, designed by Kamov . . .*"

Less ungainly than it may appear to be, this box of engineering and aerodynamic problems flew so well that one is led to conclude that its development has already reached an advanced stage. One American journal says that it is powered by Ivchenko 4,000 h.p. turboprops; and this may well be the case, although there is no direct evidence. Although the fuselage is reminiscent of that of the An-24, it is an entirely new, unpressurized, design. Passenger capacity is certainly at least 50, and one may expect to see special arrangements for heavy freight and vehicles in later versions. Each rotor appears to resemble that of the Mi-4, on a slightly reduced scale. Top forward speed is probably in excess of 200kt.

Several other new types of aircraft were seen for the first time on July 9. One was the crane version of the giant Mi-6 helicopter, an entirely logical development illustrated in our July 13 issue. On July 20 we published an indifferent photograph of the quartet of jet-propelled flying boats of the Russian Navy. They appear to be of wholly new design, which some have ascribed to Beriev, with a swept wing carrying floats integral with the tips (like the Martin P6M) and having boxes for two or four large turbojets beneath the roots. Even this unlikely aircraft, with its typically Russian tail turret, appears to be in operational service.

A Russian photograph of Bounder. This illustration was prepared from a print of much better quality than that which we reproduced in our issue of July 13, and reveals a number of significant details incorporated in the drawing on page 110

Missiles and Spaceflight



Right, astronaut Virgil Grissom is assisted into Mercury spacecraft "Liberty Bell 7" on July 21 by colleague John Glenn. Far right, lift-off from Pad 5, Cape Canaveral, by Redstone booster. Below right, Grissom with medical personnel aboard the carrier "Randolph" after he had been picked up by helicopter after his suborbital flight. The spacecraft sank and was not recovered

LIMITED SUCCESS FOR MR-4

The second manned ballistic flight in NASA's Project Mercury programme was made on Friday, July 21, with Capt Virgil Grissom, USAF, aboard the spacecraft *Liberty Bell 7*. A successful flight was followed by a failure to recover the capsule from the sea, although the astronaut was picked up safely and in good health.

Designated MR-4 (Mercury-Redstone 4), the launch took place from Pad 5 at Cape Canaveral at 1220 GMT on Friday July 21, after postponements caused by weather on July 18 and 19. The general purpose of the Mercury-Redstone programme is to advance the qualification of the spacecraft and train astronauts for orbital flights, and the main details of the MR-4 mission were reported in last week's issue of *Flight*.

A maximum height of 118 miles, a downrange distance of 303 miles and a maximum speed of 5,310 m.p.h. were achieved in the 16-minute flight on July 21. The flight went according to plan, with Grissom manually holding the autopilot-established 34° base-up attitude and firing the retro-rockets.

After the capsule had descended into the sea, Capt Grissom remained inside to complete a number of checks of instruments and equipment while an HUS-1 Marines helicopter waited to pick up the astronaut and spacecraft. He removed the safety pin from the escape hatch, and shortly afterwards the explosive bolts in the hatch fired (for a reason which had not been determined as this issue closed for press); the "door just went," and the astronaut had to swim before being picked up by another helicopter. The spacecraft filled with water, became too heavy for the helicopter which was trying to winch it up, and sank when the winch cable was cut (the HUS-1 had one wheel in the water by this time). Capt Grissom was taken aboard the carrier *Randolph* and was found to be fit, apart from having swallowed a lot of sea water and having an initially high pulse rate.

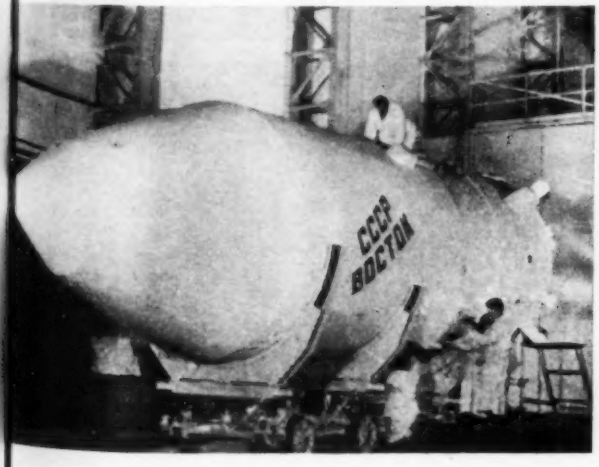
Originally it had been intended to follow this sub-orbital flight with an early attempt at orbit, with a capsule either empty or carrying a chimpanzee. A large amount of data was lost when the *Liberty Bell 7* sank, however, and this may well have caused a postponement in the Project Mercury plans for orbital flight. There appears to be a case for using a larger helicopter, such as an HR2S.

RANGER SHOT DUE

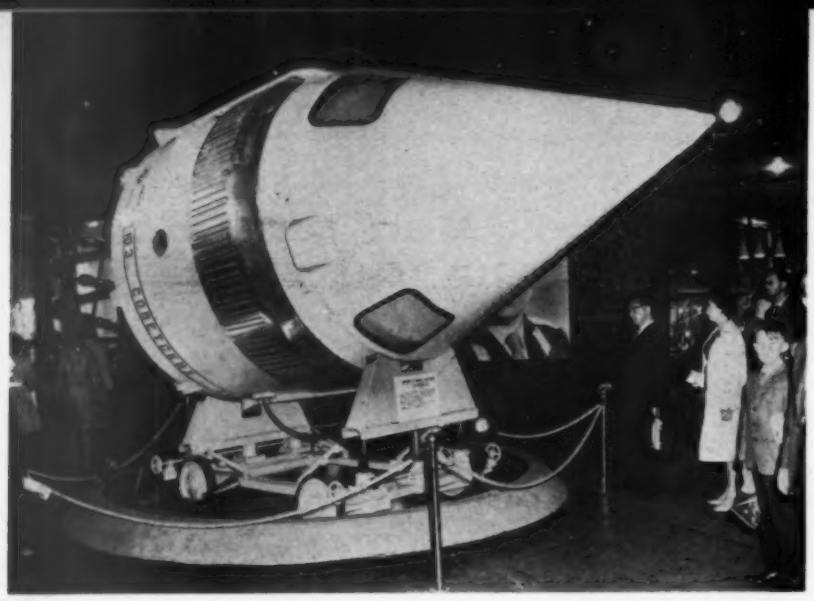
The most ambitious United States space probe yet was due to be launched by Atlas-Agena B from Cape Canaveral during this week. It is Ranger 1, forerunner of the spacecraft which the National Aeronautics and Space Administration will use to rough-land instrumented payloads on the surface of the Moon. The primary purpose of the test is to "develop and test basic elements of spacecraft technology required for lunar and interplanetary missions," including an attitude stabilization system based on celestial references, a high-gain directional antenna, an advanced communication system, the development of components able to operate for long periods in the space environment, and calibration of solar cells in a space environment.

Eight scientific experiments are carried on the Ranger 1 spacecraft, which has been developed for NASA by the Jet Propulsion Laboratory, Pasadena, California. The spacecraft has a hexagonal base slightly more than 5ft in diameter, and is 11ft long. In its "cruise" configuration, with solar panels extended, it is 17ft in span and is 13ft long. Ranger 1 weighs 675lb, of which 243lb represents electronics, 144lb the scientific experiments, 238lb the structure and 50lb the solar panels. The spacecraft has no fewer than 19,520 working electronic parts.

The Moon, Venus and Mars were the main "space neighbours of the Earth" discussed by Dr M. Bobrov, chief scientist of the Astronomical Society of the Soviet Academy of Sciences, in his lecture to the Astronautics and Guided Flight Section of the Royal Aeronautical Society in London on July 14. Dr Bobrov indicated the main points of scientific interest in the exploration of these bodies, and referred to the technique of launching space probes from a satellite in orbit around the Earth.



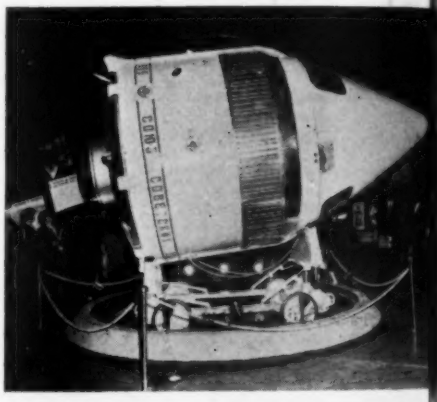
This photograph of the Vostok spacecraft (including, apparently, the final stage of the launching rocket) is taken from the Soviet film "First Journey to the Stars," shown at the international film festival in Moscow earlier this month. It is the first published view of the actual craft in which Maj Gagarin achieved orbital flight on April 12



Left, final stage of the rocket which carried Lunik 2. Right, the payload, said to weigh 390kg (860lb). Below, another view of the 1,511kg (3,330lb) final stage

Missiles and Spaceflight . . .

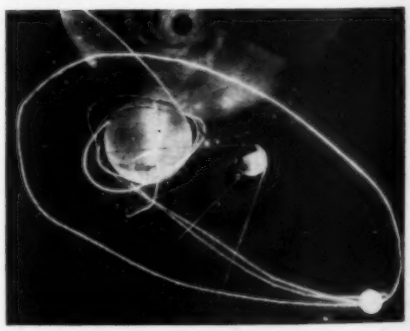
SPUTNIKS AT EARLS COURT



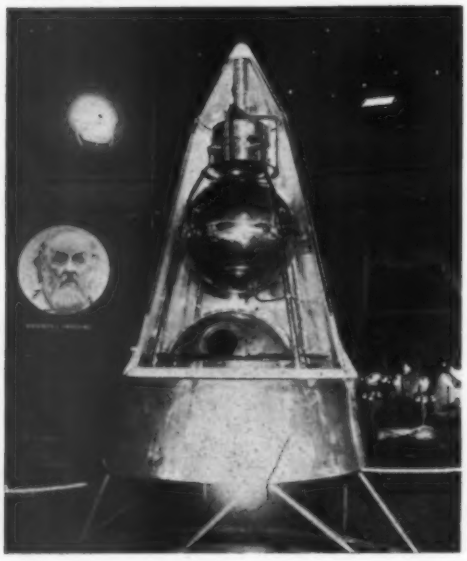
WITH Gagarin souvenirs selling well, from Vostok watches at £7 15s (marked down from £9) to spaceflight issues of *Soviet Union* at 1s, not forgetting extended-play records of the hero's voice and illustrated copies of *Soviet Man in Space*, the subject of space has been a profitable as well as a fascinating one for the organizers of the Soviet Exhibition at Earls Court. Pictured on this page are the main items of interest in the Hall of the Cosmos which forms the centre-piece of the exhibition.

The most spectacular piece of hardware is undoubtedly the final stage of the rocket which carried Lunik 2 on to the surface of the Moon. This carries a Lunik 2 replica inside the nosecone, and a dummy plug at the rear end where one would expect (or rather, not expect) to see the rocket engine. Until the exhibits were labelled, some time between Tuesday, July 11 and Friday, July 14, many visitors to the exhibition were under the impression that this was Gagarin's *Vostok*. A king-size photograph of the major on the wall beside the rocket stage carried this implication. The other replicas comprise a separate Lunik 2 payload and Sputniks 1, 2 and 3. All have been shown in public exhibitions before, but it is rewarding to see them in the flesh.

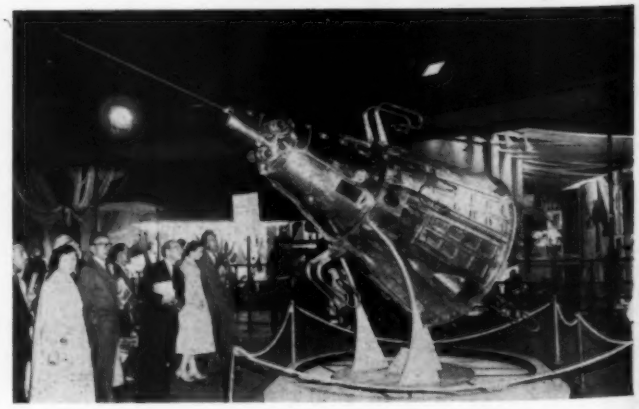
To keep the customers amused, a five-screen film show on space and a recorded commentary on the exhibits are thrown in for good measure periodically throughout the day. The films and their sound track are gloriously unsynchronized, and the films close on a suitably technicoloured science-fictional note. Another film screened in a back-projection booth at the side of the hall depicts experiments with animals to the accompaniment of a commentary in American. Wall panels depict rockets, sputniks and the pioneering work of Konstantin Tsiolkovsky. The exhibition closes at 10 p.m. next Saturday, July 29. Admission is 3s 6d, children half-price. K. T. O.

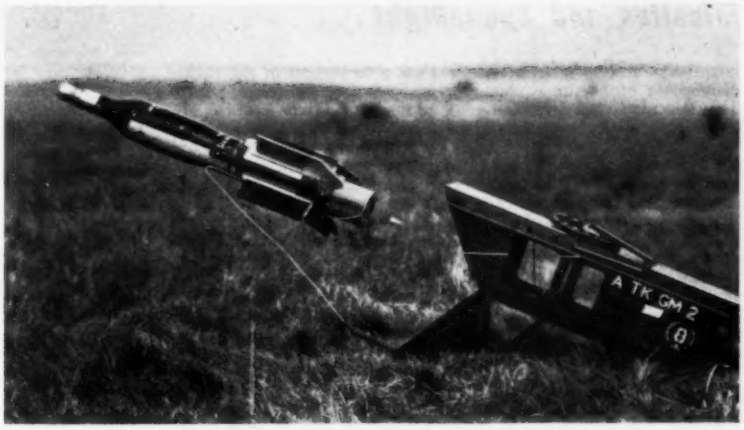


"Flight" photographs



Right, looking past Sputnik 1 towards the Earth-Moon trajectory display in the dome. Below, Sputnik 2 (left) and Sputnik 3 replicas





The best photograph yet taken of Vigilant in action. Secured earlier this month during evaluation trials at Warminster, Wilts, it shows the guidance wire, white actuator exhaust and complete absence of flash or smoke. Tank commanders have consistently failed to see a launch, even when they knew exactly where to look

VIGILANT

BY E. SMYTH, BSc, AFRAeS*

THERE can be no doubt that the most effective and economical defence against the tank is the infantry anti-tank guided missile. The basic requirements for such a weapon are that it shall be: a self-contained personal weapon system, compact and light enough to be carried and operated entirely by one man; instantly ready, and able to function reliably in any battlefield environment; highly accurate from the shortest minimum to an adequate maximum range, with a wide arc of fire from a fixed launcher; lethal to the heaviest tank; easy to learn by any soldier. A weapon meeting these requirements would, by common consent, revolutionize tank warfare and go a long way to neutralizing the Russian preponderance of armour in the West.

There have been a number of attempts at such a missile, but the one currently being given extensive field trials by the British Army is regarded by many infantry specialists as being the most promising yet produced. This is the Vickers Vigilant—a genuine one-man portable weapon whose other design specialities are high accuracy and ease of operation.

When the Vickers team began work on Vigilant, the prime requisite laid down was real portability for the infantryman. Throughout the whole development of the weapon this feature has been retained. The essential solution, which has now given an outstanding account of itself in all kinds of conditions, is described and illustrated in these pages.

The complete weapon system weighs less than 50lb, and carried on the back represents a reasonable one-man load. The system divides into: the missile; the combined launcher and container, with drum of separation cable; and the sight controller, and pocket battery. Nothing could be simpler; in the field, the setting-up and firing can be carried out by the trained soldier in under 30sec.

To launch the missile, all that is required is to press the firing trigger. No field assembly, nor any form of check test, is necessary. Pressing the firing button initiates a sequence of automatic operations within the missile. These are completed in less than 0.5sec, and the missile is then fully functioning and leaving the launcher.

The missile control in flight is the familiar optical command guidance by wire link. Vigilant carries a tracking flare at the rear (invisible to the target) which the operator sees as a circle of light. His task is to command the missile by movements of his thumb on to the line-of-sight to the target. In other words, he continuously commands the weapon into the tank. On impact at the target, a nose contact fuze detonates the warhead.

At first sight, this might seem to be yet another variant, perhaps with refinements, of the German development of World War II, from which the other infantry anti-tank guided weapons have all sprung. This is far from being the case. Vigilant has two unique features which put it in a class by itself, give it technical and tactical superiority, and also considerable development potential. These features are:

Aerodynamic control by powerful trailing-edge flaps.
An autopilot, with closed-loop velocity control in both pitch and yaw planes.

Vigilant's wings are of low aspect-ratio; their small span contributes to the small bulk of the manpack, and, because of their low aspect-ratio, large angles of attack can be used without stalling (Fig 1). At these angles, the sideways component of motor thrust considerably augments the aerodynamic force. The autopilot provides synthetic stability, and makes the control much less sensitive to changes in missile shape. The original 4in warhead was changed to the present, highly effective 5in version without change to the rest of the missile, and other warheads could be fitted without difficulty.

The Vigilant small-span wings therefore lead to a compact weapon, and minimize the risk of grazing the ground or other obstructions during flight. They also provide the large lateral acceleration required for wide coverage, for rapid sight-line acquisition, and reduce minimum effective range, particularly in the case where the operator is well to the side of the missile.

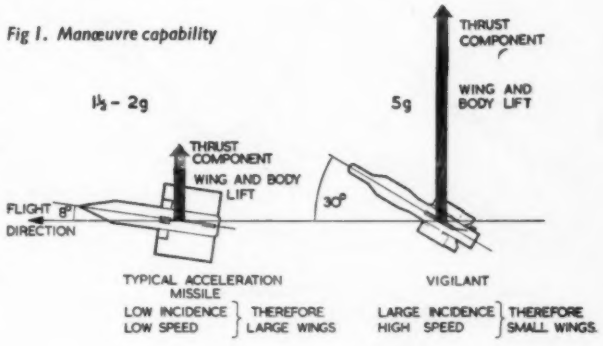
Most weapons of the Vigilant class use the acceleration type of control system. This is one which produces a lateral acceleration in response to a movement of the control stick. There are many examples of accurate human control acceleration-type systems—for example, the car and the aeroplane. These, however, are successful because the operator is in the vehicle and has an instantaneous feedback by eye and other senses. When the operator is remote from the machine and cannot sense its motion, particularly that of rotation, much of the inherent accuracy is lost and can only be partially retrieved by quite extraordinary operator skill. It is significant that the French anti-tank guided missile operator is known as "the pilot." With Vigilant a pilot's skill is not necessary, because the built-in autopilot places operation within the capability of any soldier.

Control of this type of weapon ultimately resolves itself into the two-dimensional task of commanding a circle of light on the line-of-sight to the target, and keeping it there until target strike. The simplest and most accurate form of control would be one in which a movement of the stick produced a proportional displacement of the missile.

An idealized lateral-displacement control system is illustrated in Fig 2. One stick movement only is necessary to achieve a desired missile displacement. When the stick is returned to the zero position the missile returns to zero displacement. Missile motion follows stick motion instantaneously. Unfortunately, this type of system is impossible to engineer, because almost infinite missile accelerations would be required.

Fig 3 illustrates an idealized lateral velocity system. In this case a movement of the stick produces a proportional change in the heading of the missile, and to the operator this appears as a constant velocity across his field of view. It is seen that two stick movements are required to achieve the desired missile displacement. When the stick is returned to zero after the initial command, the missile returns to its original heading, but it is left with the required displacement. Now consider the processes involved in an idealized

Fig 1. Manœuvre capability



* *Sales manager (weapons), Vickers-Armstrongs (Aircraft) Ltd*

Missiles and Spaceflight . . .

lateral-acceleration system (Fig 3). Here a movement of the stick produces a proportional change in curvature of a circular path. This appears to the operator as an acceleration across his field of view. Four stick-movements are required to produce the required displacement. Considerable skill and anticipation are required of the operator, because (a) he must judge when sufficient lateral velocity has been accumulated and must then null the acceleration demand; and (b) he must next judge the magnitude of the deceleration (i.e., curvature of path) to apply and also the exact time, so that the lateral velocity is reduced to zero when the missile just reaches the target sight-line.

Clearly, this type of control requires a high order of skill. Particularly in the case of the shorter-range targets, when the correction has to be accomplished in a short distance, the requisite skill can only be acquired by selected operators after considerable training.

Mention has been made of cars and aeroplanes. While these are acceleration controlled, to the driver or pilot they appear as velocity systems. With the steering wheel or control column held in a fixed position, the outside world moves across the field of view at a constant rate. Imagine now a system in which movement of the steering wheel is required to put the car into a bend, but in which the movement then has to be taken off to hold the car in the turn. To straighten out of the corner would require movement of the steering wheel, first the other way and then back to centre. Such a system would appear to the driver as an acceleration system, and it is easy to see that it would be much more difficult to use.

The Vigilant control system is the nearest practical approach to the idealized velocity-control system of Fig 4.

In practice, any system which depends on aerodynamic lift for lateral movement achieves the required displacement by moving in a circular path. To achieve a velocity control system two principal changes are necessary:—

(a) The missile must be "advised" when it has acquired the demanded heading, and then constrained to fly a straight course thereafter. This is done with the aid of the autopilot gyros, which provide space references. The missile obtains a measure of the angle turned-through by means of a signal generated by the gyro in opposition to the command signal. When the two signals balance, the fin deflection is zero, and the missile flies on a straight course on the commanded heading;

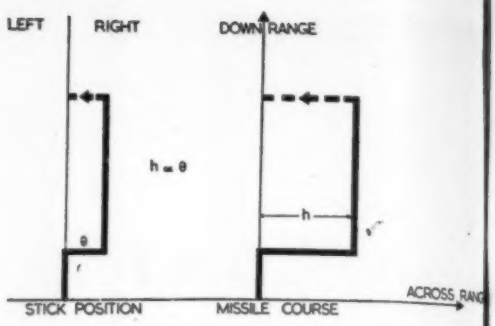
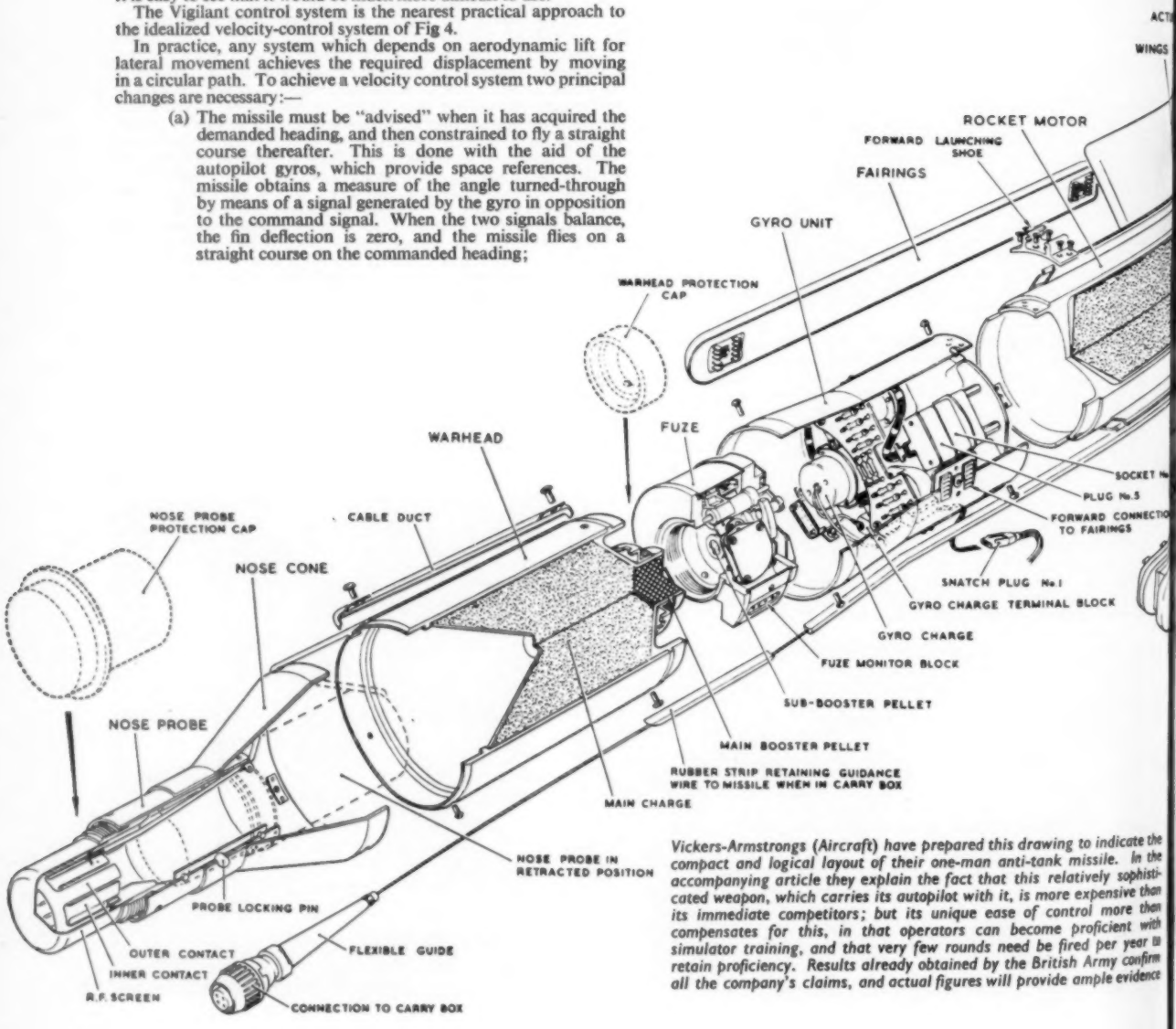


Fig 2. Idealized displacement system

VIGILANT . . .



Vickers-Armstrongs (Aircraft) have prepared this drawing to indicate the compact and logical layout of their one-man anti-tank missile. In the accompanying article they explain the fact that this relatively sophisticated weapon, which carries its autopilot with it, is more expensive than its immediate competitors; but its unique ease of control more than compensates for this, in that operators can become proficient with simulator training, and that very few rounds need be fired per year to retain proficiency. Results already obtained by the British Army confirm all the company's claims, and actual figures will provide ample evidence

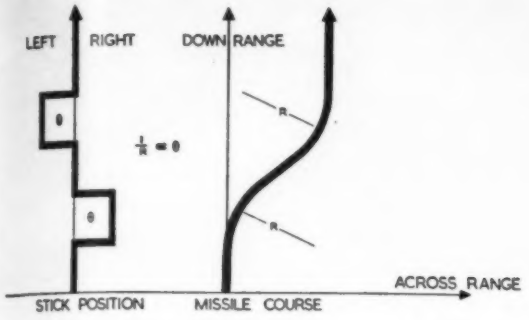


Fig 3. Idealized lateral-acceleration system

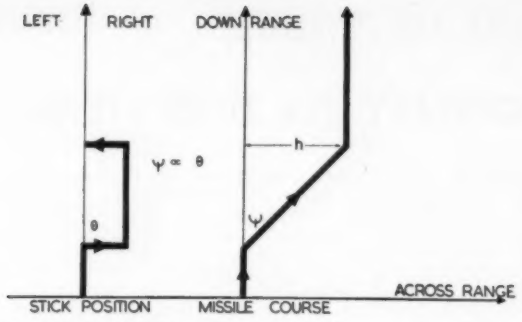
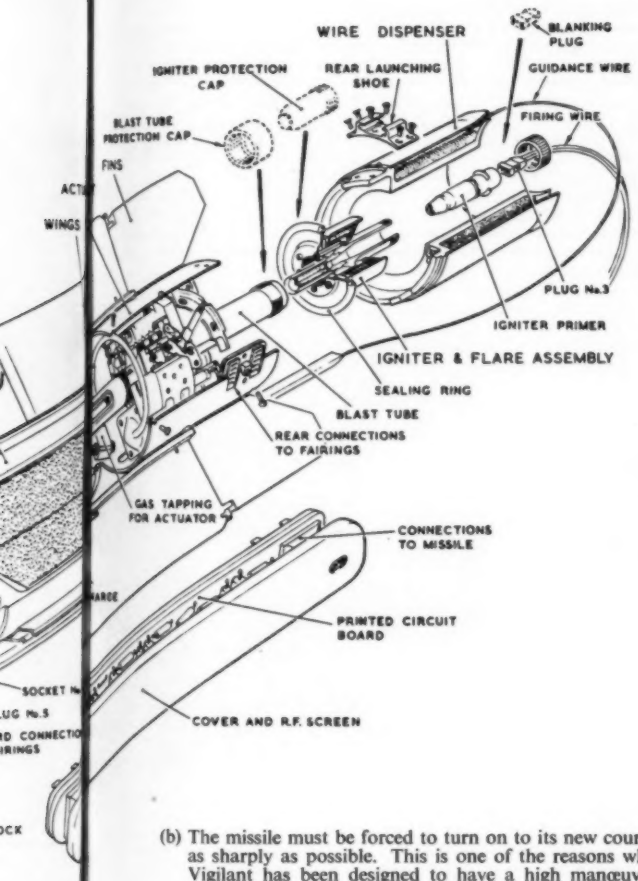


Fig 4. Idealized lateral-velocity system



(b) The missile must be forced to turn on to its new course as sharply as possible. This is one of the reasons why Vigilant has been designed to have a high manœuvre capability—that is, a small turning circle. The response must also be as fast as possible, and phase advance is used to reduce the missile time-lag.

A plan view of a typical Vigilant flight-path is shown in Fig 5. It will be seen that it departs from the ideal in that, instead of showing an instantaneous change to the new straight-line heading, the course is rounded at the "corners." If the radius of curvature or time lag were allowed to increase, the system would revert more and more to the acceleration type.

The missile can be pulled rapidly round on to the sight-line with negligible overshoot, thus enabling short-range targets to be engaged even when there is appreciable operator separation and the target is off the line of fire. When the sight-line has been acquired the missile can be flown accurately and smoothly along a straight path. If there should be a disturbance—e.g., caused by a gust or grazing an obstruction such as a bush—a change of attitude will result; but it will be immediately detected by the gyro. The missile is then automatically restored to its original heading, having been subjected to a small lateral displacement which the operator immediately observes and corrects.

The autopilot also arranges that the missile automatically levels out at a convenient height after launch, thus considerably easing the operator's task. It is also so designed that in the case of a wire breakage the missile automatically turns on to the original launch heading towards the enemy lines, thus minimizing risks to the troops using it.

In the case of an acceleration-type missile (broken line in Fig 5) attempting a similar task, the curved-path acquisition on to the sight-line is a longer and more difficult task, with a much greater likelihood of overshoot. It will be seen that the minimum possible target range is appreciably greater. The operator also has difficulty in holding the missile on to the sight-line. There typically results a weaving motion for a period of 3-4sec. The amplitude of the motion determines the error remaining in the system. This effect is due to the time-lag between the operator's applying an acceleration command and observing the effects in terms of displacement and velocity—the two parameters which he can most easily appreciate and interpret.

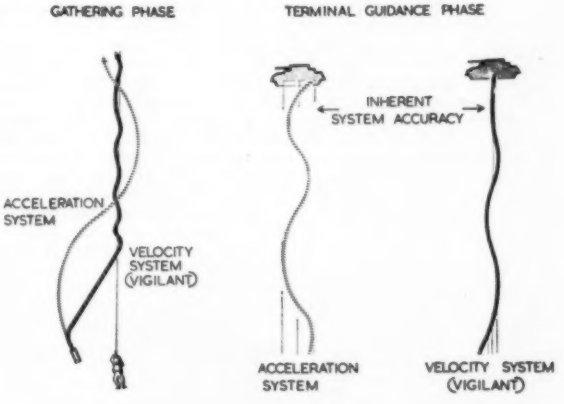
In the case of velocity control, the operator commands velocity and observes the effects much more rapidly. In other words, the time-lag of the system is much shorter, and the weave about the sight-line is negligible.

The importance of a small time-lag cannot be over-emphasized, since it is one of the most important factors in ease of control. Also, the residual displacement error varies as the square of the lag. The Vigilant lag is less than 1sec as compared with about 2sec for a typical acceleration system. This means that, allowing for the lag in perception and response of the operator, the inherent accuracy of Vigilant is greater by a factor of about four—enabling not just the tank, but the most vulnerable portion of the tank to be attacked.

The Vigilant closed-loop velocity control system has been designed to produce an easy-to-learn system, accurate over a wide range and angular coverage. Thus the first big advantage is that any soldier can be trained, and special selection is unnecessary.

Accuracy, and ease of training, also have a most important bearing on operational costs. The unit cost of the more sophisticated Vigilant must necessarily be higher than that of its acceleration-control counterparts. Analysis shows, however, that the overall costs of training in peace time and cost per kill in war-time show an advantage to Vigilant by a factor of about two. This is because of the much smaller number of training missiles required, and the superior single-shot kill probability allied with greater coverage.

Fig 5. Velocity and acceleration control systems compared



SPORT AND BUSINESS

MOONEY Mk 21 IS HERE

Mooney Mk 21 G-ARNA, the Dundas demonstrator, flying over Texas before its non-stop delivery from Boston to London

NOW available in Britain is the Mooney Mk 21, offering a best cruising speed of 180 m.p.h. and extreme range of 1,130 miles on a Lycoming 180 h.p. engine. The price of the basic aircraft in Britain is quoted at £7,718 5s 4d and the addition of full blind-flying instruments, clock, and o.a.t. gauge brings this up to £8,084 18s 5d. Numerous "packages" of extra equipment and different radio combinations are available off the production line.

The Mk 21 is in fact rather different from, and much more attractive than, the Mk 20. The laminar-flow wing and all-moving tail, both of which were formerly wooden, are now all-metal; cabin accommodation has been improved; and the latest Lycoming engine is fitted. The first example to reach England was ferried non-stop from Boston, Mass, to London, as reported in *Flight* for July 6 and 13. British distributors are R. K. Dundas, 59 St James's Street, London, SW1, and A. J. Whittemore (Aeradio) Ltd at Biggin Hill are providing a sales and service base for the type.

Neatly fitting a quart into a pint pot, Mooney have blended an attractive cabin of adequate size and excellent comfort with exceptional performance and economy. There is a large baggage compartment with a separate baggage door high up to starboard. The front seats are adjustable and recline. Instrument layout is exceptionally good with all blind-flying dials neatly grouped in front of the pilot, radio in the middle and a good, readable set of engine instruments to the right. Switches and contact breakers are tidily arranged in two groups. There is a retractable foot-rest to make the step over the flaps easy and the usual complement of ventilators and ash-trays. Both flaps and undercarriage are mechanically operated. Undercarriage suspension is by rubber blocks and the toe-operated brakes have external discs—all easy to inspect and to get at for servicing. The 40 Imp gal fuel load is carried in two integral tanks in the flush-riveted, laminar-flow wing. The nose-wheel is steerable. The elevator is centred by springs to provide correct feel and the whole tail unit, including the fin, are moved from a hand-wheel for trimming.

Mark Lambert, who flew the Mk 21 from Biggin Hill recently, reports: "The aircraft was smooth and exceptionally quiet while cruising at 75 per cent power over Kent. Handling on the ground was simple and initial climb on take-off was well over 1,000ft/min with three occupants and full tanks. Operation of the manual undercarriage became easy when the knack was learnt and there was no trim change to distract the pilot. Flaps brought a firm nose-down trim change, but the tailplane would cancel out all loads down to 70 m.p.h. or less. The stall came with a slow wing- and nose-drop and ample warning at below 60 m.p.h. With everything down, application of full power produced only a mild nose-up trim change and the Mk 21 climbed at 300ft/min before gear and flap were raised. A power-off approach can safely be made at just above 70 m.p.h.

"At cruising speed, stability and handling were very pleasant though there was some control friction in this new aircraft. Aileron control remained fully adequate to the minimum speeds, but the rudder was not strong enough to produce any sustained side-slip at speeds below 80 m.p.h. Such a manœuvre is hardly necessary in this aircraft and there was enough rudder to cancel torque in climb and descent. Particularly impressive was the tidy and accessible arrangement of instruments and switches and the atmosphere in the cabin was very pleasant. The broad windscreen side-pillars did not interfere with visibility and I could see the ground and the sky around me very comfortably. Aileron-wheel travel was small and I could lay out maps comfortably on my knees. The King radio was simple and performed well with the roof-mounted loudspeaker. Ventilation was easy to adjust and ample for warm days. There were two adjustable instrument lights in the roof.

"Altogether, the Mooney is an exceptionally attractive little aeroplane. One could travel really comfortably in it and use the airways and airports alongside the big boys. Most encouraging for after-sales service is that Mooney are now increasing production from one to two per day."

The four-seat cabin is well furnished and controls and instruments are exceptionally well arranged. Front seats slide and recline. Windscreen and side-windows are slightly tinted

"Flight" photograph

THE ARROW ACTIVE 2, entered in this year's King's Cup race and illustrated below, has a particularly interesting history going back to 1930. Between 1930 and 1932 two Active aircraft were designed and built, the Mk 1 being of mixed wood and metal construction and the Mk 2 all-metal. The two machines were basically the same in external appearance, except for top-wing position and variations in the shape of the fin and rudder.

It was in 1958 that the Active 2 re-emerged, having been rebuilt by Rollason Aircraft and Engines Ltd of Croydon. Following a flight from Croydon to Fair Oaks, the aircraft ground-looped on landing, damaging the lower mainplanes and main gear. This was attributed to a lack of directional control during the landing, caused by a blanketing of the fin and rudder by the fuselage (the shape of the vertical tail was long and low, and a fully free castoring tailskid did not help ground handling). Later the same year, Mr Eric H. Smith was engaged to undertake a repair scheme for the aircraft, including the redesigning of the fin and rudder to give better rudder control, and the provision of a steerable tailskid.

"Flight" photograph

The redesigned fin and rudder were higher and the rudder was of greater area than on the original aircraft. The new units were manufactured by Universal Flying Services at Fair Oaks, who also effected the complete repair of the machine, and the Active became airborne again early in 1959. In that year's King's Cup race the aircraft nosed over on take-off, because of too much throttle, and pitched over on to its back. The damage incurred on this occasion was repaired by Rollasons with the assistance of Mr. Smith.

In the 1961 King's Cup race at Coventry, earlier this month, Denis Hartas achieved an average speed of 142.5 m.p.h. in the Active 2. The structural design of the type is described by Mr Smith as absolutely first-class, even applying today's standards to the 1930 machine, although a greater tail arm would give improved stability.

Arrow Active 2 G-ABVE, pilot Hartas, on the King's Cup starting line at Coventry. A speed of 142.5 m.p.h. was achieved

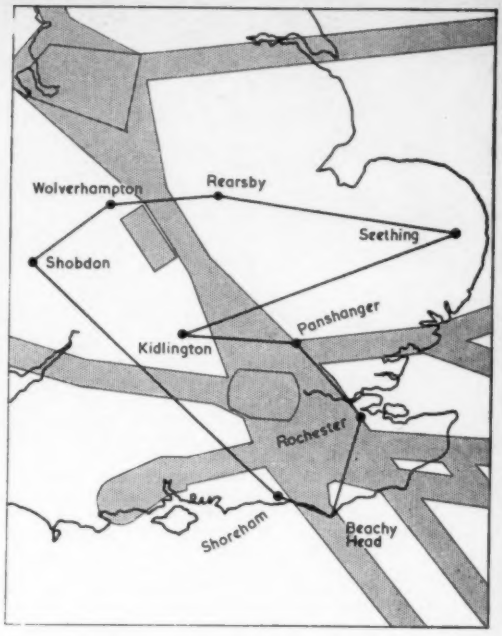
The Business Aircraft Contest

KIDLINGTON, Oxford, is the base chosen for this year's International Business and Touring Aircraft Competition, organized by the Royal Aero Club and the Business Aircraft Users' Association, which is to be held tomorrow and Saturday, July 28 and 29. The contest comprises a distance event on formula (see map) on the first day, followed by tests at Kidlington on the second day.

The overall winner will receive the Royal Aero Club Diamond Jubilee Trophy, and the winners of the three classes into which the aircraft are grouped will be awarded respectively the Osram Cup, McAlpine Cup and Beagle Cup. Class 1 contains single-engined single- or two-seaters up to 2,204lb gross weight; Class 2 is for single-engined machines with more than two seats or exceeding 2,204lb but not exceeding 12,500lb; and Class 3 embraces multi-engined types up to 12,500lb.

In the distance event aircraft in the first two classes are permitted to refuel at one or both of two specified turning points, while Class 3 machines are required to complete the course without refuelling. The second-day tests will be devoted to short take-off, short landing, and judging of aircraft on the basis of comfort and convenience, general condition and flight operating equipment fitted, and baggage capacity.

The following article, a competitor's guide to the competition, has been written by one of the pilots who is participating.



CONTEST PROSPECTS

IT might be said of this year's business and touring competition that it sets out to measure the success of a compromise. Every aeroplane design is a balance between this factor and that factor and, by examining most of the attributes with which, to a greater or lesser extent, the designer imbues his brain-child, the competition should discover this year which is the very best business aeroplane. It is not simply a question of which is the most expensive aircraft in its class, although undoubtedly first cost and equipment cost figure in the equation. Nor is the competition purely one of flying skill, although pilot ability, too, will inevitably influence the end result. The aircraft that wins will be fast, economical, and with a good short-field performance, but it will also be comfortable, beautiful, and practical for day-to-day operation.

Of course, in setting all these *desiderata*, the Royal Aero Club and the Business Aircraft Users' Association have themselves been faced with some of the problems that face the aircraft designer. How much weight should be given to good performance? How much to navigational equipment? How important is it that, when all the tanks are full, there is space and payload available for a full complement of passengers? How many marks should be awarded for baggage capacity? What value should be placed on range?

So in some ways, in the second competition of this type, the rules and markings are just as much open to questions about the best choice having been made, as are the wide variety of types that are competing for the accolade of Best Business Aircraft.

Readers may recall that, in spite of this being the second contest of its kind, the competition last year really proved nothing at all, except what was already self-evident—that if the weather restricts the competition to landings and take-offs, it is the modern, high-lift-device aeroplane that is going to win.

By force of circumstances, the big question last year left unanswered was: Which aeroplane represents the best balance between the conflicting requirements of good short-field ability, good payload capacity, speed, and economy? And having determined all this, which business aeroplane then best fulfils all the car-like functions of utility, comfort, equipment, visibility and quietness?

More importance is being attached this year, in the contest at Kidlington, to the touring side of the balance sheet. Much the same formula for determining efficiency is being used as in 1960. It takes into account achieved air miles per gallon, block speed and payload, but this year the course distance is much greater, about 620 miles instead of 380. This heat of the competition carries a maximum of 1,500 marks.

Starting at Kidlington the crews will fly north-east to Seething in Norfolk, west *via* the Airedale kennels at Rearsby to Shobdon, near Leominster, south-east to another Beagle centre at Shoreham, via Beachy Head to Short's light-aircraft base at Rochester, across the river to Panshanger and—after nearly six hours in the air for some—perhaps a bit wearily home to Oxford.

Results will be judged on the formula:—

$$\text{Marks} = \frac{\frac{\text{Course distance}}{\text{total fuel used}} \times \frac{\text{Course distance}}{\text{elapsed time}} \times N}{10}$$

$$\text{Where the factor } N = \frac{\text{No of seats (160lb + lb baggage per seat)}}{180}$$

or number of seats, whichever is the smaller.

Some of the factors affecting the award of points under this formula were discussed prior to the contest last year (*Flight*, May 20, 1960), and all that it is proposed to review of this aspect here is a brief reminder that it is possible to plot, for an aircraft where a good manual is available, curves of air miles per gallon × true airspeed against, say, percentage power for a series of altitudes. The basis of this plot is curves of altitude against TAS, and altitude against range at various powers. By equating altitudes it is then possible to determine the height at which air miles per gallon (range divided by full tankage) × block speed (TAS used as an approximation) reaches its maximum. This is the cruising condition we are looking for.

Unfortunately, such comprehensive information is not often provided, though its usefulness is undeniable. (It can be revealed now that the graphs printed a year ago were constructed from the manual for the Mooney Mk 20A, a dark horse which, had it entered and had the full contest been held, could have done well.)

Now supposing that a good manual is not available, probably the best that can be done is some practical flying to determine empirically fuel consumptions at various power settings and altitudes. In any case such a technique could well be adopted by entrants whose aircraft demand high cruising altitudes, and who are anxious to determine the best climb and descent techniques to achieve highest block speed and minimum air miles per gallon. It is extraordinary how little information on cruise-climb and cruise-descent techniques is given in most owners' handbooks. Best off are probably the owners of Beeches and Cessnas with fuel-injection engines. The fuel pressure instrument—that inevitable if unsatisfactory adjunct to non-automatic fuel injection—is really a flow-meter, and with the fuel-pressure computer all the usual sums can be worked out in reverse to arrive at just the right power settings to achieve a known flow of fuel. Since this circular slide-rule computer also makes an allowance for temperature, a bit of intelligent pre-flight planning should pay handsome dividends.

Unfortunately, it is also generally true that most of the business aircraft types equipped with fuel-injection engines require to operate at considerable heights to achieve their best performance. A 10,000ft cruising height is simply not practical when there are seven

Short take-off tests, introduced at last year's Business and Touring Aircraft Competition at Shoreham, will again be featured in this year's contest. Here a Piaggio P.166 clears the 10ft barrier at Shoreham

"Flight" photograph

Among the aircraft participating at Kidlington is this Bellance 14-13 Cruisair Senior (owner Ron Flockhart, pilot Alastair Pugh)

Sport and Business . . .

turning points on a 600-mile course, at all of which aircraft have to descend low enough to be identified: this presumably means down to about 500ft. The best choice of altitude under these circumstances will be quite a ticklish problem, and in practice not many pilots seem likely to elect to fly at heights much above 3,000ft, if only because the course includes the crossing of two control zones, Amber One airway outbound to Seething and between Rearsby and Shobdon, the London TMA on the way to Rochester, and Amber One again on the last leg from Panshanger home to Kidlington. If immediate R/T crossing clearance cannot be given, precious gallons are going to be wasted.

There are a number of new twists to the rules for 1961, of which perhaps the most interesting is the one concerning residual fuel. After fuel remaining at the end of the course has been computed by measuring the number of gallons needed to fill up on landing and subtracting it from the fuel tankage, a bonus allowance is made at the rate of one mark for every minute, up to 60, that the aircraft could continue to fly at the same achieved fuel consumption and block speed. This rule was clearly devised to try to prevent competitors setting off to fly for 620 miles with fuel only for 619, but it also opens the door for some careful judgment on residual fuel. To gain full marks a twin with a block speed of, say, 185 m.p.h. and a consumption of nine air miles per gallon has got to carry perhaps 21 additional gallons of fuel, or about the weight of an extra passenger.

Would the exchange of a passenger for this amount of fuel be worth while? The answer is almost certainly "No," since the maximum marks are only 60 for residual fuel but the effect of passenger variations in the formula $\frac{A \times Vb \times N}{10}$ is acute. Taking the figures above, and varying the load by filling either four seats so that sufficient fuel remains for one hour, or five seats so that there is no remaining fuel, the allocation of marks would be as follows:—

Four seats	Five seats
$\frac{9 \times 185 \times 4}{10} + 60$	$\frac{9 \times 185 \times 5}{10} + 0$
$= 642 + 60$	$= 834 + 0$
$= 702$	$= 834$

No variations have been played on the factor N in the calculation above, but the result is quite clear: the road to high marks is to fill all the seats.

This really leads on to the next calculation. Since marks are awarded for the number of seats filled, fuel remaining at the end of the course, and weight of baggage carried, the problem is to adjust the load so that it is absolutely right on the maximum written into the Certificate of Airworthiness. Last year, a certain amount of confusion arose because the rules apparently did not make allowance for many aircraft (of which *Flight's* Gemini is one) which are payload-limited and seat-limited with full fuel.

This year, the regulations have been adjusted in the following way: only those fuel tanks that are "declared" have to be filled, while others not used in the distance event can be sealed off. Passengers may be better fed this year (they must weigh at least 160lb each as against 130lb last year) and must be accompanied by 20lb of luggage each, except that the entrant can *substitute the equivalent weight of passengers and baggage by ballast or sealed-off fuel.*

It is this regulation that makes possible a wonderful variety of choices on loading; passengers, baggage, ballast and fuel can all be selected in just the right quantities to gain the maximum marks for payload, to adjust the c.g. to get best cruising performance, and to finish the course with just the right amount of fuel. The sum is even more complex for the shorter-range aeroplanes in groups 1 and 2, because it must be decided if refuelling stops will be made at either Rearsby, or Shoreham, or both. There appears to be nothing in the regulations to prevent competitors in these two groups flying anti-clockwise around the course to gain the ideal distance-since-refuelling, always provided that they are properly identified at the turning points. But intending competitors reading this suggestion are strongly advised not to accept it without a check from the Clerk of the Course.

So every entrant, over the past few weeks, will have been juggling with figures for equipped weight, maximum weight, fuel tankage and course distance apart from all the performance sums that have gone before. Let's take a look at a couple of examples, one for a single and one for a twin, in order to find out what this part of the competition is all about.

Aeroplane A is a twin, with an all-up weight of 3,800lb, 75gal fuel and an equipped weight of 2,400lb. B is a single, weighs 2,200lb fully loaded and carries its fuel in two 15gal tanks.

For A, calculations are relatively straightforward. The total distance must be covered without refuelling, so that both tanks will be required and will be full; total fuel weight is $75 \times 7.2 = 540$lb. That leaves 860lb for passengers and baggage. Five 160lb passengers weigh 800lb, so that there is a reserve of 12lb of baggage for each passenger. This will not buy full marks, and the factor N will be

$$\frac{5\,(160 + 12)}{180} = 4.77$$

But we shall try to get back a little by flying with only two pilots, weighing together, say, 330lb, and stowing 530lb of ballast in such a way that the c.g. is a little further forward than it would be with five passengers.

For our single-engined aeroplane the problem is different. By leaning-out and flying slowly we can achieve 6gal/hr, or about 21 a.m.p.g. But our cruising speed will give a block speed of only 130 m.p.h. (rather a good aeroplane, is B) and, using all our fuel, we should be right on the margin for distance. In fact, we should be too marginal to be safe.

Do we refuel once, or refuel twice? A quick check on the map shows that it is about 226 miles to the first refuelling point, and about 50 miles less than this home from the second. Suppose we fly on full tanks, and refuel at Rearsby. We shall then have 30gal in the tanks on which to cover $615 - 226 = 389$ miles. At 20 a.m.p.g. and 140 m.p.h. block speed B will use 19.5gal to the end of the course and gain the maximum bonus marks of 60. In fact we shall really be carrying an excess of fuel. Aeroplane B is fast and economical, but its thin wing makes it a poor weight-lifter, so that with full tanks it can carry only three passengers and 35lb baggage. Can the course be flown on a single 15gal tank? The answer is clearly that it can, since those 15gal are sufficient, at 20 a.m.p.g., for 300 miles. But it will be necessary to accept the penalty for three landings and three take-offs, and our first idea on best cruising altitude and block speed will have to be modified, however astute we are at performing close-in circuits and climbs that are economical in time and fuel.

Passengers or Fuel?

Suppose for argument's sake that our a.m.p.g. figure reduces to 19.5 and block speed to 126 m.p.h. How many marks can we expect to gain then? Well, with fuel in one tank only and the other sealed off, we shall actually be under maximum weight. Some fuel might even be spared as a "balancer." Four passengers at 160lb weigh 640lb, 20lb of baggage each accounts for another 80lb, and 15gal fuel brings the total up to 828lb. Disposable load is 835lb so that we have 7lb to spare. So if the opposite tank is then filled with fuel and sealed, we can leave out one passenger (more room for the one in the back) and ballast the balance of the weight, i.e. $(160 + 20) - (15 \times 7.2) = 72$lb ballast.

On formula, the single-engined aeroplane will then achieve

$$\text{Marks} = \frac{19.5 \text{ a.m.p.g.} \times 126 \text{ m.p.h. block speed} \times \frac{4(160\text{lb} + 20\text{lb})}{180}}{10}$$

$$= 983$$

Then does the single-engined aeroplane win? Not a bit of it. There are still all the airfield tests on Saturday to perform. To the author's personal regret as a spectator, the easy-starting test which was such fun at Shoreham has this year been dropped. The take-off and landing tests remain, and as such are as much a test of judgment as of performance. How many entrants this year will again understate their take-off distance and cut the 10ft barrier too fine? For the landing, on the other hand, new techniques must be devised. Another 10ft barrier is to be erected at the start of the landing area, so that the ultra-flat, power-on, low-speed approach must be changed for a higher rate-of-sink descent. Marks awarded are 300, with one mark deducted for every two yards of landing or take-off run.

Finally, there are up to 700 marks to be won for comfort and convenience, baggage capacity, general condition and flight operating equipment fitted. Here the twins can regain many of the marks that they may have surrendered to the more economical and short-field aircraft in classes 1 and 2. That equipment carried can also have a very practical purpose in this competition, since if the weather is poor, good radio navigation equipment carried on a 600-mile course will be much to the pilot's advantage. And it must not be forgotten how great is the bonus for piloting and navigation skill, which in a business and touring contest—as in business flying itself—is perhaps just as it should be. A. T. P.

The "Flight" Gemini at Warsaw/Okecie. Left to right are Mr Wazniak, Motoimport representative, Mr Pazik, PZL test pilot, Stuart Cassy of "Flight" and Mr Orlowski (presenting furled umbrella), Motoimport representative in England

"Flight" photograph

EXCURSION POLONAISE

BY MARK LAMBERT

1: Gemini to Warsaw

IT all started as a casual suggestion which no one took very seriously. Motoimport, the Polish export organization, intimated that *Flight* might like to come and see them in Warsaw; and we replied that we would even like to fly there in our Gemini. Then we all realized that there was really no reason why the trip should not come about. We applied for, and were immediately given, visas for three and permission to fly. Hectic telegrams finally established that we would be allowed to use Air Route 7, which runs from the Polish north coast at Darlowo, opposite Bornholm, down to Grudziadz, on the Vistula, and thence via Skierniewice to Warsaw/Okecie. We could use route 7 throughout one day, but must not depart from it at all. Total distance over Poland was 237 n.m. We had no radio compass with which to use the three NDBs, and they were in any case marked "HS" (hours of scheduled service only); but we heard of Alpha Alpha homer on 119.7 Mc/s which was operating on test at Grudziadz, 100 n.m. inland along Route 7. Maps were a bit of a problem but Stanfords in St Martin's Lane produced some RAF and USAF half-million sheets which covered us nicely, and the Royal Aero Club provided much useful information and assistance.

The Gemini was, incidentally, the first British light aircraft to fly into Poland since September 1939.

Universal Flying Services at Fair Oaks spent a hard week trying to cure persistent plug-oiling in our Gipsy Majors and we finally set off in wonderful eight-eighths blue weather for Lympne. Here we spent the usual hour or so filling in forms and waiting for petrol before flying in three hours to Bremen. Customs, refuelling, briefing and refreshments were accomplished in quick order in the most friendly atmosphere and we landed at Kastrup 1hr 50min later with two DC-6s and a Caravelle delaying their take-off for us.

A night stop at the fabulous Tre Falke hotel set us up well for an anxious hour next morning with a compressed air bottle, trying to inflate an expired tail-wheel tyre without bursting it. Then off to Bornholm, again in astonishing "eight-eighths blue," for a final refuelling to give us maximum endurance over Poland.

Bornholm is charming, with a good runway, teletype-link to Kastrup, Customs on request, the most friendly people imaginable and a good line in Danish sandwiches a short crash-tender ride down the road. We cleared Customs outbound at Kastrup with the simplest Danish General Declaration and were not customed at Bornholm at all. First check was the flight plan, which had to go via Kastrup and Hamburg and then in an once-an-hour exchange of messages to Warsaw. We would cross the Polish coast long before our flight plan got through, the Danes said, and we would certainly be intercepted by Migs.

"Flight" photograph

Final discussions at Bornholm before crossing the Baltic to Poland. Warnings of Migs turned out to be unfounded

Rather looking forward to this, we took off and made the 27min sea-crossing on instruments in dense goldfish-bowl haze, but hit Darlowo "on the nose." No Migs. We pressed on over a rolling country of forests and lakes, with hardly a single positively fixable landmark. On Alpha Alpha's frequency of 119.7 Mc/s I heard KLM flight 296 talking and called him several times without result. He was working Alpha Alpha and Warsaw. After switching off for a while, I then heard KLM 296 calling us blind and telling us that the Poles had no notification of our flight plan. So they had spotted us anyway. The next thing was a call direct from Alpha Alpha, at extreme range for our tiny radio, saying anxiously that we were west of the airway centre-line—an awkward mistake.

At that moment we fixed ourselves by two very distinctive lakes, altered ten degrees left and continued all the way on track. I told Alpha Alpha we would be out of radio touch for another 40min and would then call Warsaw. After two hours over Poland we saw Warsaw, landed off a base-leg approach on Okecie's runway 33 and taxied up to the tower. A crowd collected, but the Gemini was immediately wheeled off into a hangar and we were told it would be sealed up. No one understood what I meant when I tried to clear Customs and I finally asked them to put their big red stamp in the journey log, just for the line book.

After six busy days (some results of which are recorded in subsequent pages) we made the flight back to England. It went smoothly, with the only exception that we had strong head-winds all the way—27kt on one two-hour leg. In Warsaw I had to make a flight plan two days before take-off, but otherwise everything was straightforward. We were held on the ground for 20min while several airliners took off, and then started the long slog over the same relatively featureless countryside. In due course we again made contact with Alpha Alpha, and he could not have been more helpful or efficient, passing bearings, weather "actuals" for Bornholm and handling a number of airliners above us at the same time. His English was good. A cheery farewell and we pressed on over the forested lakeland to Darlowo and started the sea crossing again. The only thing we saw was a torpedo boat which raced across our course, reduced speed and turned slowly round below us. We could not see her nationality, but she was obviously interested in us. She had had to race over to us because we were off course, the cross-wind having dropped at the coast, and we should have recognized the implications. But we droned on and eventually saw Bornholm off to our right.

We cancelled the flight plan by radio and continued on to Malmö to try a new place for a night stop. We had been in our seats for four hours and flying for 3hr 40min to cover 380 n.m. It was quite enough for anyone in a Gemini and our passenger was so stiff he fell and punched a small hole in the wing when climbing out. We filled up with 51 of our 66 gallon capacity. Next day the wind was in our teeth and we rattled on for six hours, landing at Bremen and Rotterdam for fuel and food before being hospitably accepted by Gatwick and cleared through Customs in almost record time. The whole flight, about 1,000 miles each way and taking a total flying time of 19hr 15min, was more an exercise in physical endurance than actual flying skill. Serious map-reading was only necessary over Poland and parts between Bremen and Holland.

Finally, if you have radio and want a quick, helpful clearance out of or into England, try Gatwick: there the welcome is efficient and good. We had to complete more paper-work at Lympne than in the eight other Customs landings we made during the journey—and took a proportionate length of time to do it.

"Flight" photograph

Brand-new from PZL is the PZL-104 Wilga utility aircraft shown in the two views above. It has yet to make its first flight

EXCURSION POLONAISE . . .

2: Poland's New Products

DURING the last ten years the Polish aircraft industry has been through many trials and tribulations: orders fluctuating between mass production and nothing at all, design teams assembled and then broken up again, acute shortage of suitable engines for the smaller aircraft, and so on. Today government economic planning envisages aircraft as an important export, and great efforts are being made to increase sales on the one hand and to prepare a new group of designs on the other. Already a highly successful series of high-performance gliders has been produced; during the past year two of them have been imported into Britain.

In the powered field, the little Kos trainer is in production and a number have been exported. *Flight* published an "In the Air" report on the Kos on June 10 last year; and I flew the type again twice at Warsaw. External paint finish, interior furnishing, sound-proofing, elevator trim control and other details have all been greatly improved since the first, hard-worked prototype SP-PAM toured Britain, and the Kos is now an attractive club trainer. The price, at £2,625, is remarkably reasonable; it includes two years' provision of spares, and covers for outdoor parking. The Kos is still one of the very few side-by-side two-seat trainers capable of full aerobatics and spinning which a small club could afford to buy and run. There is also the prospect of buying a Kos without engine and fitting the Continental C-90-12F in Britain, new or secondhand. PZL are most anxious to provide value for money and to re-establish their enviable pre-war reputation for light aircraft.

Another type which I flew twice was the PZL-101 Gawron, which is an extensive redesign of the Russian Yak-12. A real work-horse aircraft, it is already selling well in several countries, including Austria. The basic machine is a four-seater, but full equipment for rapid conversion to dusting, spraying (oil-based or water-based), glider-towing and ambulance work is provided, and all the necessary equipment and tools, as well as a stock of spare parts, is included in the basic price of only £8,000. I flew the Gawron fairly extensively and found it to be tough, well-arranged and docile, with exceptional slow-flying and short-field capability. I flew it for some time in simulated crop-spraying runs at low level and found it very manœuvrable. A fuller description of the Gawron will appear as an "In the Air" report in a future issue.

While we were in Poland I heard that PZL are now flying their jet trainer prototype powered by a Polish-made turbojet of 2,000lb thrust. It is called the TS-11 Iskra (Spark). Another aircraft, which we were unfortunately unable to see at the time of our visit, is the MD-12 four-engined, 20-seat transport. But another type which we did see was the brand-new PZL-104 Wilga, which had been exhibited at the international trade fair at Poznan, but has yet to make its first flight. Powered by 180 h.p. WN6 or 220 h.p. WN6R opposed engines, the Wilga is intended eventually to replace the PZL-101 as an all-purpose aircraft. The pictures above show the neat layout of the cabin with its full-access doors and good control arrangement. The cantilever wing has full-span, fixed slots, integral tanks and slotted flaps and ailerons. A single electric flap-motor is mounted accessibly in the cabin roof. Wheel-brakes are pneumatic and suspension by oleo.

All flying controls in the Wilga are by push-pull rods; and an electric winch in the tail allows the glider-towing rope to be wound in after the glider has cast off. The cabin floor is flat and extends well back behind the rear seats, so that stretchers or bulky freight can be accommodated. Agricultural equipment can be fitted.

Principal data on the Wilga are: span, 36ft 2in; length, 26ft 2in; wing area, 167 sq ft; empty weight, 1,540lb; gross weight, 2,530lb; fuel load, 400lb, sufficient for six hours' flying; wing loading 15lb/sq ft; power loading, 14lb or 11.4lb/h.p. according to engine; cruising speed, 100 m.p.h.; minimum speed, 37 m.p.h.; range, 620 miles; ceiling, 16,500ft; take-off distance, over 50ft, 620ft; landing distance over 50ft, 560ft.

The Wilga can accommodate full instrumentation and radio and has been designed to British CAR, Section D, Category N.

For some years PZL have been producing the Russian Mi-1 helicopter under licence as the SM-1W—one was exhibited at the Paris Salon two years ago. Now they have developed a more economical version which, called the SM-2, is related to the original rather as the Widgeon is related to the Dragonfly. The SM-2 has an extended five-seat cabin with a door in the right side of the nose allowing direct loading of stretchers. Again, various versions are available, including ambulance, agricultural and winch-rescue. The 575 h.p. Lit-3 seven-cylinder radial engine of the SM-1 is retained, together with the original three-blade rotor system and liquid de-icing for main and tail rotors.

The SM-2 I saw was the first civil machine—others have gone to the Polish Air Force—and, because it was a single-control machine, I was not allowed to fly it; but I did have a passenger ride. It was evident from the feel of the unboosted controls on the ground and from the frequent trimming during flight, even after small adjustments, that control was pretty heavy. Powerful springs centred the cyclic stick and the spring datum was altered by electric motors controlled from a button on the hand-grip. The twist-grip was used very little and had to be unlocked by a trigger each time it was moved. Rotor r.p.m. were between 235 and 250 and the collective lever remained almost constantly co-ordinated with throttle. The clutch for transmission engagement appeared to be directly

Left, the PZL-101 Gawron, development of the Yak-12, with some of the crates of agricultural equipment and tools which are included in the basic price. At right is the SM-2 helicopter, a five-seat development of the SM-1, with nose-door for stretcher loading

"Flight" photograph

controlled by a lever on the right and produced a rather rough engagement after the engine had been warmed up. Another right-hand lever controlled the rotor brake; and levers on the left operated shutters for both engine- and oil-cooling air.

The SM-2 is equipped for extreme-cold operation and even has a de-icing fluid supply to the windscreen-wiper blade. Heating and demisting are provided. Probably for similar climatic reasons, the engine is started by compressed air from a bottle charged by an engine-driven pump, and fed directly into the cylinders to turn the engine. The Gawron has a similar system.

If de-icing, heating and radio compass are not fitted, the fuselage locker of the SM-2 can be used to carry 88lb of baggage. When five occupants are on board, a 3.3lb ballast weight has to be attached to the tail-rotor gearbox so that the cyclic stick-neutral position does not travel too far aft.

In the air the helicopter behaved well, with noise- and vibration-levels average for this type of machine. We cruised at about 87 m.p.h., but maximum speed is 105 m.p.h. Range on internal tankage is 200 miles, but external tankage will increase this to 310 miles. Hovering ceiling is 6,100ft. Empty weight is 4,230lb and maximum gross weight 5,610lb. The SM-2 is available for export at a very reasonable price.

3: Vintage Interlude

DURING two visits to Goclaw I cast longing eyes at the Po-2s standing outside the hangars. Some were ambulance versions for pilot, patient and attendant and one or two were three-seat VIP transports, but the rest were olive drab, dual-control trainers, looking like World War I bombers. They were built under licence in Poland as the CSS-13 until two years ago, but are now totally obsolete and the club is keen to sell them. I offered £50 for one, fly away Warsaw, but they wanted £1,000.

The CSS-13 is really a most amusing machine, sturdily built, weighing 2,000lb and powered by a 125 h.p. five-cylinder radial with open valve-gear. The duplicated control cables run outside the airframe and there are very wide walkways on each lower wing.

As a great joke, I was eventually allowed to fly one with Mr Jensen, one of the ambulance pilots and formerly with No 138 Sqn, RAF. He wore a fine fur-lined flying helmet and goggles and, leaning over from his rear cockpit, pointing out some controls, said "No aerobatics" and indicated forcefully that maximum engine r.p.m. were 1,760.

The Tiger Moth cockpit is small and cramped compared with the throne-like accommodation of the Po-2, which is designed for strong men bundled up in arctic winter clothing. We sat head-and-shoulders above the coaming, but protected by fairly large windscreens. Unusually comprehensive equipment included full blind-flying panel, heater, a heated recess for a clock, carburetter hot-air control, full navigation lights, landing lamp and both upward and downward signalling lights. The big bucket seat was very comfortable and full Sutton-type shoulder harness was provided. The pupil normally flies from the front and non-duplicated controls are located there.

Starting procedure is fascinating. The engine is primed and a man hooks a long pole round a propeller blade and yanks one cylinder onto the compression stroke. Then the front pilot cranks vigorously at a coffee-grinder magneto on the floor of his cockpit and the engine bursts into life, the movement of almost every part being audible, if not actually visible as well. Puffs of exhaust emerge in distinct order from each short exhaust pipe.

The tail-skid is steerable, but, because the wing-loading is only about 5lb/sq ft, opposite aileron and all the other old tricks have to be used when taxying in winds. There are no brakes. Up in front, the valves of the top cylinder popped slowly up and down as the engine idled, firing one cylinder after another in slow succession. I applied power and the valves became almost blurred. Full throttle gave just less than full r.p.m. and the tail came up immediately as we gathered speed and drifted into the air, to the accompaniment of shouted comments from Jensen. "Climb at 100km/hr," he yelled, and we sailed upwards at 400ft/min.

The writer and Mr Jensen of the ambulance service prepare to fly the CSS-13, Polish version of the ubiquitous Po-2

"Flight" photograph

The controls felt extremely heavy—almost rigid in fact—and something other than aerodynamics seemed to mask most of the feel as the speed built up to 130km/hr (81 m.p.h.) at 300m and I throttled back to keep the r.p.m. down. The rate of roll was infinitesimal if ailerons alone were used, but the rudder was like a barn door and wheeled the aircraft round at a decent rate. The trimmer was effective in cancelling elevator loads when the stick began to feel like a heavy stone.

Although the initial impression of handling was a bit brutal, I soon began to enjoy the feeling of puttering along in the fresh air. The effects of slightly bumpy atmosphere could be easily countered and the aircraft seemed to have real hands-off flying characteristics. Steep turns were easy to co-ordinate if I used plenty of rudder when rolling. Visibility was excellent. I reduced speed and brought the CSS-13 back to the stall. It behaved in a classic way and drifted slowly into the most docile possible downhill waffle with the stick hard back at an indicated 55km/hr (34 m.p.h.). At low speeds the controls did not become very much lighter, but the aircraft was remarkably docile. Side-slipping was astonishing. I managed to swing virtually sideways in each direction. The approach, made at 105km/hr (65 m.p.h.), was extremely flexible because of this ability. The landing, too, was simple, with a classic three-pointer coming easily at the end of a waffling float. I grew to like the CSS-13 very much. It is the sort of aircraft on which one could build many happy memories.

4: Clubs, Ambulance Service

ONE day we were taken to Goclaw airfield, just across the Vistula from Warsaw, to see the headquarters of the club, ambulance and agricultural services. We were received by Col Wierzbicki, the chairman, who told us something of how the 500-member, 80-aircraft centre in Warsaw is run. The selection of aircraft included —apart from many gliders—Junak 2 and 3, Yak-12, Zlin Trener, An-10 and CSS-13 (the Po-2 development referred to above) the last two being used for parachuting. The club movement has five sections, respectively for powered flying, gliding, parachuting, ballooning and modelling. The resident balloon was away at the time of our visit.

Entrance, at least to the first four sections, is open to anyone who is over 16 and is nominated by two members and who has a school certificate and a recommendation from his teachers. Members' ages vary from 16 to 60, and 99.9 per cent of them are active partici-

"Flight" photograph

Club and ambulance aircraft at Goclaw airfield, outside Warsaw. They include Junak 2 and 3, Zlin Trener, CSS-13, Morave, Aero 145, SM-1 and a training glider

Aero 145 and CSS-13 of the ambulance service at Goclaw. The former is extremely popular with pilots and the latter is effective for operations from tiny fields or, on skis, in deep snow

"Flight" photograph

EXCURSION POLONAISE . . .

pants in their sections. Entrance fee is 20 zlotys (about 7s) and the annual fee is 10 zlotys, plus five or ten more for each section to which the member belongs. Of the 500 members at Warsaw, 250 are glider pilots, 150 powered, and about 100 parachutists. There are no privately owned aircraft in Poland.

The club largely manages its own finances, following a state subsidy based on a budget prepared by the club. Once a member has joined he must fly a minimum number of hours—or make a certain number of jumps—each year, but there is no maximum. In powered aircraft he flies solo after about ten or 12 hours' dual and gains his third-class rating with an oral exam and flying test after about 50hr. During the initial training period he is encouraged to spend as much time as possible at the airfield and to join extensively in both the technical and social activities of the club.

After 80 to 120hr he can take a second exam and flying test to gain his second-class rating; and after three years and 150 to 200hr he can become a first-class pilot. Instrument flying and aerobatics are necessary for second-class, and advanced aerobatics and night flying for first-class ratings. Most of the instructors are voluntary.

Members are carefully observed in their behaviour, aptitude and application to work and are accordingly trained for specific types of flying, such as glider towing, crop-spraying, parachute dropping and weather reconnaissance—the last-named requiring some experience of poor-weather flying. The keener pupils are encouraged and brought on by the instructors and their progress is closely watched. Glider and parachute instruction follows broadly the same principles. Each parachutist maintains his own equipment and, to encourage talent, tables of records classified as national or international, male or female, individual or group, are kept on the wall of the parachute room. Plastic "bone-domes," special jumping boots and barostatic releases of both Polish and Russian manufacture are used. It costs the club 400 zlotys per jump to give a parachute pupil his first ten qualifying jumps. At Goclaw four half-days each week are set aside for parachuting.

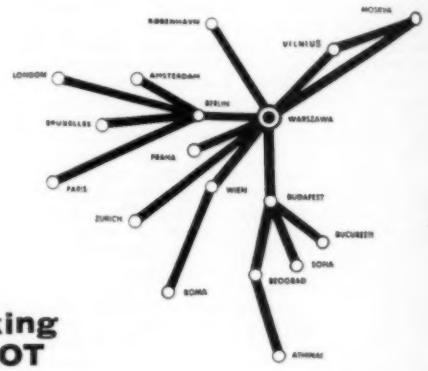
I asked Col Wierzbicki about the use of aircraft for private journeys and the possibility of flying abroad—in fact about business flying. His answer was that this kind of flying does not fit into the scheme of the organization. The emphasis in the club movement is on training and on perfection in various types of flying. Because the government provides the means whereby people may fly at virtually no cost, it demands in return a serious approach to the corporate activities of the club. Throughout the year the performance of the more skilful members in each section is assessed and the instructors choose, on the basis of both "social" and aeronautical achievement, a team of perhaps ten people who will represent their club and country in foreign competitive events.

There was an atmosphere of enthusiasm and a sense of purpose at Goclaw which clearly showed that skill and achievement are taken very seriously, just as scholastic achievement is taken very seriously in Poland's schools. Those in charge at Goclaw were proud of their activities and pointed out that the organization of the club was entirely Polish and not based on any other example anywhere else in the world. Trophies and badges in many rooms recorded friendly visits or successful competitions in many countries.

Also based at Goclaw is the headquarters of the Lotnictwo Sanitarne, the Polish air ambulance service. Formed in 1955 with six CSS-13s at two bases, the service now has ten aircraft based at Goclaw and two each at 15 or 16 provincial bases. There are 50 pilots, and nurses and doctors are seconded from the hospital service. Each base has its own first-aid facilities, road ambulances and teleprinter communication with other bases and hospitals. Types of aircraft include the Aero 145, "the best light aircraft to reach Poland since World War II," Morava, Brigadyr, PZL-101 Gawron and a few of the ambulance version of the Po-2, still used in winter and where specially difficult landing conditions exist.

During the last two years, helicopters have also been introduced and an SM-1 was based at Goclaw. The new Wilga will in due course be added, and when economical small helicopters are available they will take over all flights of less than 150km. A single Morava at Goclaw is at the moment used for VIP transport and forest fire-spotting, but a version carrying two stretchers and an attendant is available.

Under its director, Tadeusz Wieckowski, and chief pilot, Mr Plenkewicz—who was one of the three Polish test pilots at RAE Farnborough during World War II—the service has transported 20,400 patients in five years and the aircraft together fly about 14,000hr each year. Pilots fly for up to 400hr each year. Both casualties and patients being transferred between hospitals are carried, and blood, isotopes and medicines are delivered. Patients have been flown as far afield as Stockholm, Prague, Vilno, Budapest and Bucharest for specialist treatment available only in these places; and the Aero 145s bear servicing instructions in English to facilitate handling in foreign countries. Some of the aircraft are fitted with skis for operation in the severe Polish winter when road transport is often impossible. The average experience of ambulance pilots seemed to be extremely high and the service as a whole well organized, busy and efficient.



5: Looking at LOT

ONE of the most rewarding parts of the trip was an interview with the director of the Polish national airline LOT and a look round its maintenance facilities at Warsaw Okecie airport. The director, Jan Krzywicki, told me something of his airline's plans for expansion of the already extensive route network and for re-equipment with medium and long-range aircraft.

During the present five-year plan, just started, LOT would like to start a transatlantic service to New York and Chicago to exploit the considerable tourist traffic of Americans of Polish origin. In fact, however, this particular scheme is unlikely to be realized until the next five-year plan. Meanwhile, expansion of services to the Middle and Far East is a definite prospect for next season. LOT's three new Il-18s, already flown for some 200hr, and in scheduled service to Moscow, will later begin to fly the Budapest-Belgrade-Athens route and then extend to Cairo or Beirut and eventually to Baghdad, New Delhi and Jakarta.

All the major British, American and French manufacturers have approached LOT with a view to selling long-range equipment; but, like other Polish concerns, the airline has difficulty in obtaining foreign currency. It receives 24 zlotys for every US dollar it earns abroad, but must pay half as much again for every dollar it has to spend for spare parts, fuel or services abroad. At one time the East German Baade 152 was a firm prospect for medium-range re-equipment, but that project has now been abandoned. Next in favour is the Tu-124, now being operationally tested by Aeroflot; and the twin-turboprop An-24 looks attractive for short-range routes.

First priority is to modernize the international fleet and to bring the Il-14s and Convair 240s back on the internal services to replace the Li-2s. LOT has 12 Il-14s—five bought in Russia, six in Germany and one in Czechoslovakia. Present seating capacity is 26, but it is planned to increase this figure to 32 or 36 according to the capacity of the aircraft of various origins. Some Il-14s have been stretched by a Czechoslovakian company to seat 40. Four Convair 240s serve London, Paris, Rome and Amsterdam; and

One of the three LOT IL-18s at Warsaw/Okecie, ready to fly a scheduled service to Moscow. Later, they will fly to the Far East

LOT's internal route network covers 2,721km with six year-round routes from Warsaw to Kracow, Wroclaw, Poznan, Szczecin, Gdansk and Rzeszow. In summer direct services between Kracow and Gdansk and between Wroclaw and Gdansk are added. Load factors average 80 per cent over the year and 100 per cent in summer. The routes are served by eight 22-seat Li-2s and cost of fares is between that of railway 1st class and 2nd class with sleeper. On internal routes, LOT carried 109,611 passengers during 1960, making 37,376,000 passenger-kilometres. The eight Li-2s flew 7,564hr during the year, a figure considered reasonable in view of the overhaul schedules and other factors. Average flying time per day per aircraft was three hours, but aircraft often flew as many as nine hours.

The passenger aircraft are also used, with seating removed, for freight duties. Some 85 metric tons of strawberries were flown abroad, reaching the wholesalers within 24hr of being picked in Poland; five metric tons of elvers were flown out in June for restocking eel fisheries; and sweet-water crabs have been exported and cargoes of monkeys flown in from India.

LOT is responsible for its own operation and maintenance and employs 1,500 people, but there is a separate organization responsible for airfield maintenance and construction, provision of navigation aids and similar services. Runways at Warsaw/Okecie are being extended and a new terminal is being built. For aircraft re-equipment, the airline prepares a specification stating the required range and capacity and indicates which of the aircraft on the market would fulfil the requirement. The suggestion is then forwarded to the Ministry of Communications and the Planning Commission and a decision is taken, in the light of all the circumstances, to buy one type. The Ministry of Foreign Trade is then instructed to make the purchase.

I was also taken on a rapid tour of inspection of the maintenance base at Okecie. A modern building houses the engine overhaul department dealing with Ash 62s for Li-2s, Ash 82s for Il-14s and P & W R-2800s for Convair 240s. The Il-18 turboprops are now also coming through the shops. Overhaul life of the R-2800 is 1,500hr, and the engine sometimes achieves 1,600hr. The Russian engines are much more conservatively lifed, the Ash 82T now being prepared for an increase from 700hr to 1,000hr life. But, says the company, they more often reach their full life because of this conservatism.

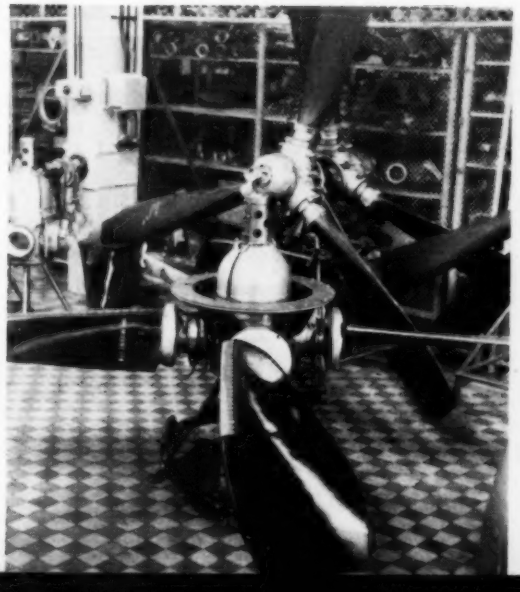
The shops are fully equipped for stripping and assembling, treating and repairing components and engines and complete records are kept for each individual engine. A twin-bay test cell for Ash 62 and 82 engines is nearing completion and one cell is to be equipped with a British-made (John Curran) test stand for Il-18 engines. Every tenth Ash 82 is bench-run for five hours and then stripped again and checked before being finally tested and installed. Propellers are also overhauled. Overhaul life of the Il-18 engine has just been raised from 200hr to 500hr, the lower life having apparently been imposed following the accident last year at Kiev.

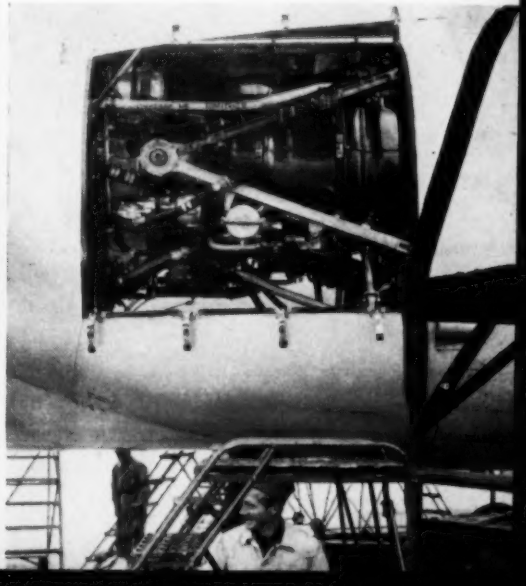
Instrument and autopilot test rooms are also available, the complete stand for testing the Russian hydraulic autopilot of the Il-14 having been designed and produced by the aeronautical section of the Warsaw Polytechnic. Test equipment for the electronic autopilot of the Il-18 is to be prepared. Radio maintenance presents some problems, because Russian, English and American equipment has to be handled for the various aircraft. Multiple test benches have been specially made by LOT to test all makes of similar equipment on one bench. Five different types of VHF radio are in use—two Russian, one British and two American.

Most interesting among the Russian radio equipment, I thought, was a 500 channel VHF radio which, complete with its power supply and shock mount, measured about 14in along its sides and appeared to weigh between 20 and 40lb. It is partly transistorized, contains only 11 crystals, has 100kc/s channel-spacing and gives an output demonstrated to be 25W with a sensitivity of three microvolts. The power pack contains a dynamotor and conversion circuitry producing 115V, 400c/s, and cooling air is accepted through the main carrying handle from an aircraft supply. Any one of the 500 channels can be immediately selected on a very small digital tuning selecter separately mounted. Finish and construction seemed to me to be well up to the best standards of workmanship anywhere.

Finally, LOT allowed me a brief inspection of an Il-18. Pictures of an engine with cowlings open and of a propeller with spinner removed appear here. The five-man flight deck was neat and was mainly painted pale grey. The engines normally constant-speed at 96 per cent r.p.m., giving 12,300 turbine and 1,060 propeller r.p.m. Torque gauges indicate power output when the single control levers are moved, and autofeather is provided. The weather and navigation radar has two scopes for the pilots, apparently intended to provide stand-by in case of failure of one tube. There is a third scope for the navigator. The LOT cockpit layout on this aircraft was virtually identical with those already seen in Aeroflot aircraft and the passenger cabin had accommodation for 14 first-class and 70 second-class passengers.

"Flight" photographs





Close-ups of an IL-18 propeller and the port side of No 2 engine. Both were taken at the LOT maintenance base

Straight and Level

WITH one great twang of his propaganda bow Mr Krushchev shoots off a quiver of startling new manned military aircraft. How nice to have been able to keep them secret all this time. If it is Mr K's intention to make the West bankrupt itself in an arms race, he could not have executed a better or more well timed ploy.

Imagine the flutterings and gnashings-of-teeth in the Air Council, the to-ings and fro-ings along the corridors of power in the Ministry of Aviation, the Air Ministry and the Treasury. "*Let us not panic, gentlemen. Stop crying, Air Marshal Molesworth-Dither—pull yourself together. Yes, perhaps we were wrong to cut back on manned aircraft and to concentrate on missiles. But, we must keep calm, and review the situation in this new light . . .*"

* * *

How nice for Mr Krushchev to run a system of society in which he can plan, allocate resources and build weapons in secret. How easy to compete with countries in which his agents can pick up on public bookstalls intelligence a thousand times more useful than a thousand U-2s. The East-West struggle is like a race between two runners, one of whom is blindfold, gagged and anæsthetized.

There is of course just a chance that these new Russian jets are old Migs and Yaks aerodynamically done up with cardboard at the cost of a few roubles. But we can't be absolutely sure, can we?

It's a jolly chizz and not fair.

Not bad. Not bad at all. But they really must do something about the condensation in this cabin, its ruining my new jet age uniform

"I am sure it wasn't like that when I took off." For further information about the object of Mr Beverley Snook's interest see below, middle column

● One of the less routine occupational hazards of air racing is illustrated in the picture above. An unserviceable a.s.i. and bad visibility caused Mr Beverley Snook to divert to Exeter in his Spitfire 9 during the London - Cardiff race. He landed, taxied in, and prepared to shut down the engine. At this moment the port wing exploded. Bit and pieces were blown to a height of 100ft.

Mr Snook (thinks): Had I continued to Cardiff, I would have been taxying up to the Duke of Edinburgh at just about the time of the explosion. Even after diverting to Exeter, two minutes earlier I would have been in the circuit; one minute later I would have been standing on the wing.

Possible cause of the incident was a fuel leak, with the explosion caused by a spark from the engine exhaust.

● Four hundred passengers, delayed ten days at Potters Bar airport last week, appeared before a Ministry of Aviation court yesterday charged with causing malicious damage to the offices of Dependable Airways.

Putting them on probation, the chairman said: "This regrettable incident did not further the development of British civil aviation. There may be some grounds for believing that Dependable Airways had no licence to operate, no aircraft, no traffic rights from the Ruritanian authorities, and owed a petrol company and other creditors a little money. But these passengers had made *bona fide* bookings, and the public must be made to realize that they cannot go around treating our airlines in this disgraceful way."

Mrs E. Jones of Chorley Wood, spokesman for the passengers, apologized sincerely.

● "Plummet Air Lines, good-morning. May we put you on our waiting list?"

"No, this is Sir John Blackout-Jones of Scruggs Aircraft calling Sir Charles Boost. Is he there? Thank you. Hello? Ah, Boostie—Blackie here old boy. You well? Wife all right? Splendid. Look, old chap, I'm afraid . . ."

". . . I know, don't tell me, there's going to be another delay in the delivery of our Speedmasters. What is it *this* time, eh? We were supposed to have the first in January 1953. ARB being awkward again, I suppose."

"Yes and no—well, you know how it is, Boostie. I don't have to keep telling you what a difficult business it is building aeroplanes. A difficult business."

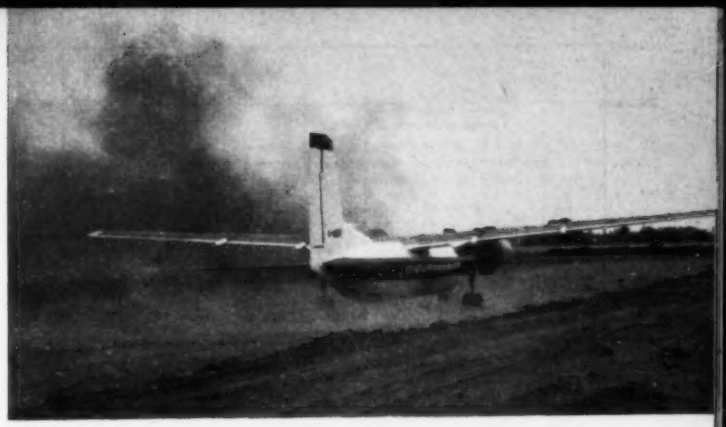
"It isn't exactly a Ministry contract running an airline, old boy. What's gone wrong this time, eh?"

"Well, it's a bit technical, to do with the wing or some other proprietary item—nothing to do with Scruggs of course, though naturally we do not shrink from taking full responsibility for our products—you know that, Boostie. Anyway, I'm sending along one of my brightest chaps to see you. He can explain everything. Must go, old boy—just off on another world sales tour. Cheerio."

● "Who said you could make an outside brickhouse fly if you give it enough thrust? This aircraft clearly shows that very moderate thrust will do."

ROGER BACON

AIR COMMERCE



A specially prepared unprepared surface is the only way to describe the deliberately churned-up rough strip from which this Herald is taking off. The aircraft was being put through rough-field performance tests at RAF Martlesham Heath for the benefit of Service chiefs; it took off at full load in a 17kt crosswind in 300yd

ATLB PUBLIC MEETING 21 (Continued)

ON this page begins our fifth report of the Air Transport Licensing Board's hearings into 70-odd European and UK domestic route applications. Apart from the official transcript (which is available only to the parties involved) this is, we believe, the fullest summary of these important hearings to be published. A leading article is on page 105; on the next three pages appears a small selection from the voluminous statistical evidence presented in application and objection.

ASKED by Mr Marking (for BEA) his opinion of the possibility of re-negotiation of bilateral agreements on terms more favourable to the United Kingdom, Sir George Cribbett said he did not regard the possibility very highly. The agreements were bilateral and mutual, not statements of UK requirements: the conditions which the British Government could obtain were limited by what other countries were prepared to concede. He confirmed that, at the ICAO conference in 1944, Britain had pressed, unsuccessfully, for liberalization of traffic rights: further efforts at the European Civil Aviation Conference at Strasbourg had been equally unsuccessful. Meanwhile, the attitude of the United States Government was hardening and a major US airline had pressed the CAB to reduce the transatlantic frequencies of two European airlines.

Mr Marking then asked him about the suggestion that a second carrier would draw all the traffic from fifth-freedom operators. Sir George thought the suggestion unreasonable; fifth-freedom traffic was usually carried by a particular airline for a special reason; people tended to travel, where possible, on their national airlines. Frankfurt was an American garrison and consequently the two American airlines operating there tended to carry most of the American fifth-freedom traffic to Frankfurt. If the British Government were to designate a second carrier to Frankfurt it would have to negotiate with the German Government for traffic rights and this would inevitably lead to a reduction of BEA's rights on the route.

The next witness for BEA was Mr S. F. Wheatcroft. Mr Marking established his witness's status as an air transport consultant and economic adviser to BEA, then asked him to say how he interpreted the duties of the Board in respect of the probable damage to BEA, mentioned by Mr Milward, should the applications be granted. Mr Wheatcroft said that all appeared to agree that the Board must act to benefit civil aviation. He did not agree, however, with the argument that BEA was now big enough to stand a little competition. Although properly regulated competition could be beneficial, competition could also, in certain circumstances, be harmful. Granting of the applications would not further the development of British civil aviation.

Asked for his views on the economics of intensive expansion, Mr Wheatcroft said that short-haul operations were expensive because of (1) lower hourly productivity of aircraft due to lower average speeds on short sectors; (2) lower annual utilization of aircraft and crews because of time spent on the ground at more frequent terminal and transit stops; (3) high incidence of station and terminal costs; (4) high incidence of costs on a per passenger basis (reservations, etc).

Wheatcroft On High Intensity

These disadvantages could be offset by exploiting the advantages of high-intensity operation, such as (1) the operation of large aircraft; (2) high frequency, which attracted more traffic and increased load factors; (3) increased throughput of stations.

These were the fundamental principles of successful short-haul operation and their observance had accounted for BEA's successes in the past. Mr Wheatcroft therefore concluded that, in order to further the development of British civil aviation, the Board must direct its policy towards securing the economics of intensive expansion in the air transport business.

Asked by Mr Marking to speak of the relation between airline and aircraft size and operating costs, Mr Wheatcroft said that unit costs decreased as the scale of operations increased up to a certain point—perhaps 150-200 million c.t.ms.—and did not tend to decrease again thereafter. The important point was that the cost level of smaller airlines was liable to be higher than that of larger airlines on similar operations. It was likely that the minimum size of an airline for economical operation would increase.

Specialization of operation, he said, was even more important than scale. Design of aircraft and equipment specialized for the job led to enhanced economic standards. The applicants could not achieve either the size or the specialization to benefit from these economies unless they were granted such a large share of traffic as would seriously damage BEA.

Mr Marking asked why Mr Wheatcroft believed that the effects of the proposed competition would be unfavourable to British civil aviation and Mr Wheatcroft said that developments in Canada, the USA and Australia led him to this belief. He confirmed that in 1958 he had prepared a report for the Canadian Government on the implications of competition on Canadian air routes. This report had been published and the summary was before the Board. At the time the situation in Canada was similar to that being considered by the Board. Mr Wheatcroft said that the arguments in favour of competition were that it promoted better service and more rapid technological progress, provided the public with a choice and provided a yardstick of efficiency. Nevertheless the effects were not always beneficial. For example, too-rapid technological progress might be disadvantageous. It was possible that competition in Europe might lead to the general introduction of jet aircraft, at higher operating costs than the Vanguards, with unfavourable effects on fares.

Possible advantages from competition would not outweigh the risk of higher operating costs. The split of traffic on the routes would raise each airline's cost level. Such a split was only economically possible on routes with a high traffic volume. Asked what conditions of route traffic would support competition, Mr Wheatcroft referred to the attempt made in his Canadian report to assess this volume, based on an assumption of a "commercially desirable frequency for economic operation." He thought the most important part of the report was its attempt to establish numerically the traffic volume necessary before it could be assumed that traffic could be split without increasing cost level.

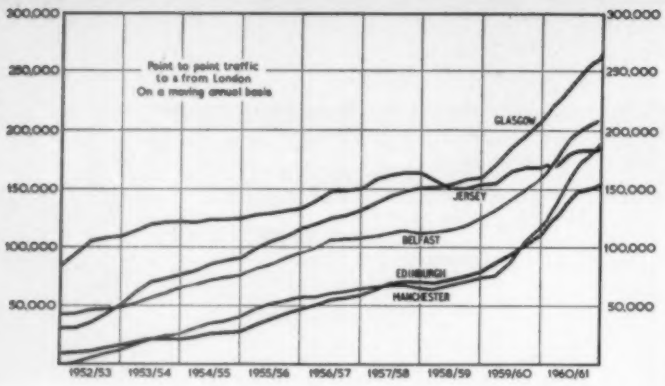
Traffic Required For Competition

At this point he introduced document BEA 58, a table based on 12 route-distance groups, varying between 0-100 and over 3,000 miles, and setting out the "commercially desirable daily frequency," the "probable frequency aimed at by each of two competing airlines" and the "monthly traffic each way needed to sustain two competing airlines," using 40-, 60-, 80-, 100- and 120-seat aircraft. On longer routes, he said, each airline might aim at the full commercially desirable frequency, but not on the shorter ones. (These frequencies varied, in the table, from 14 for routes of 0-100 miles, down to one for routes over 3,000 miles long.) A load factor of 70 per cent had been assumed in estimating the traffic required to sustain operations.

Mr Marking then asked about the situation in the United States. Mr Wheatcroft said that this was a competitive system and quoted the pronouncements of the CAB in 1943 in favour of competition. This "presumption doctrine" and its application had been considered by Gill and Bates in their study *Airline Competition*; they had not quarrelled with the doctrine but with its application by the CAB. They came to the conclusion that adverse results followed competition on routes where the traffic could not support economic frequencies. Asked how the conclusions of Gill and Bates' *Airline Competition* (published in 1949) applied today, Mr Wheatcroft quoted the annual report of American Airlines for 1960 to the effect that all operators were suffering from excessive parallel duplication of services, resulting in low load factors and consequent high specific costs to operators and, consequently, to customers as well.

Dealing with Australia, Mr Wheatcroft said that most of the internal routes in the country were operated in parallel by TAA and a private airline. This system was no longer effectively competitive because of the controls imposed by the Airlines Equipment Act of 1958 under which the types of aircraft to be operated and capacities were limited. Schedules were not controlled, however, and this had led to parallel operation with similar aircraft at identical times, always the best traffic times.

Mr Wheatcroft said he agreed with what Sir George Cribbett had said about the implications and effects of international agreements. He would add that the full advantages of competition were obtained (according to Gill and Bates) when there were two carriers; the introduction of more could have harmful results. Because dual designation would mean a split of the British share of the traffic it was fallacious that it would lead to additional orders for British aircraft. He was not in favour of pools and would like to see conditions which would make them unnecessary; but changes in the nationalist and protectionist policies of many governments would have to precede any general



BEA's domestic-trunk passenger traffic over the years

AIR COMMERCE . . .

liberalization. In his view the traffic volume justified more than one operator on only one of the routes applied for (London - Paris).

Asked about the domestic services, Mr Wheatcroft said that they were a different problem; there was at present no competition and he would favour a second carrier if the traffic would support two, but that was not yet the case. To illustrate his argument he introduced document BEA 59, on which, against six domestic routes, were tabulated the "commercially desirable frequency" for the route length, the BEA monthly passenger averages, and the monthly passengers required to sustain two competing airlines operating 60-, 80- and 100-seat aircraft. This showed that the rapidly increasing traffic on domestic trunk routes would be overtaken by the increasing BEA capacity and, therefore, the time was not yet ripe for competition.

Mr Wheatcroft was asked by Mr Marking what size aircraft he had considered when saying that the London - Paris route could support two operators. Referring to the figures for a route of 101-200 miles, on table BEA 58, he said that even on this route Vanguards might not be justified with two airlines operating [according to this table 35,400 passengers a month each way would be necessary to sustain the 14 flights which two airlines would probably operate assuming they used 120-seat aircraft]. Summing up, he said that he would recommend that the Board, in the general interest of British civil aviation, should reject the applications for licences on both international and domestic routes.

Mr Wheatcroft was then cross-examined by counsel for BUA, Mr Gardiner, who said he assumed Mr Wheatcroft thought the Government had been wrong in passing the Act. Mr Wheatcroft said he did not think so. The Act was an enabling act only; it was for the Board to decide on the applications.

Wheatcroft On Pooling

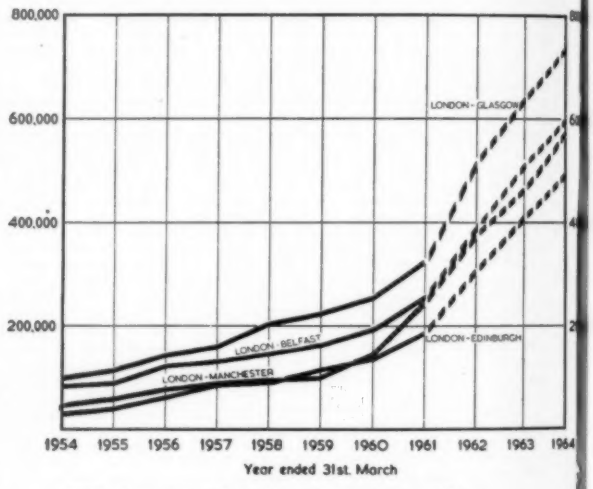
Mr Gardiner quoted from Mr Wheatcroft's book (*The Economics of European Air Transport*) passages criticizing pooling agreements. Mr Wheatcroft said that the criticism of restrictions on capacity referred not to pools but to inter-governmental agreements. Mr Gardiner insisted that the passages quoted referred to the general undesirability of pooling agreements. He quoted a further passage stating that the "economic consequences of the effect of airline competition are not susceptible to measurement from one route to another," and suggested that Mr Wheatcroft's use of arguments based on Canadian data about European airlines went against this principle. Mr Wheatcroft maintained that the cases were generally similar, and Mr Gardiner referred to differences in route lengths, and density and distribution of population as important points of difference. Mr Gardiner asked whether Mr Wheatcroft did not agree that the arguments advanced in his book (written five years ago) in favour of competition on European airlines should apply even more now. Mr Wheatcroft denied this; he said that aircraft productivity, in capacity-ton miles per hour, had increased to such a degree that competition could now be less easily sustained. Mr Gardiner quoted, from Mr Wheatcroft's book, comments about the very few circumstances in which pooling agreements could be justified, and the desirability for some degree of public regulation of any that might be made. Mr Gardiner also quoted the opinion expressed by Mr Wheatcroft, in a lecture to the Royal Aeronautical Society, that cross-subsidization of routes was financially and socially undesirable and suggested that this applied to BEA's claim to support the operation of unremunerative domestic routes from the proceeds of profitable international services. Throughout, Mr Wheatcroft agreed that he had expressed the opinions quoted, but did not agree with the conclusions Mr Gardiner drew from them. Some time had passed since his book was written and conditions had changed.

The Chairman asked Mr Wheatcroft to explain the heading "commercially desirable daily frequency." Mr Wheatcroft said that this related the time of flight over a particular route distance to a frequency which would attract traffic by giving a reasonable time-saving in comparison with alternative methods of transport. It was not related to traffic volume, which would tend more to dictate the size of aircraft to be used at the established frequency. Mr Gardiner suggested that, as traffic on the various routes would double by 1965, the very small diversion that could be produced by the limited intervention of one of the applicants would scarcely cause a calamity. Mr Wheatcroft said that the total diversion which would be effected by the granting of all the applications would result in a reduction in productivity which would adversely affect the economics of operation. BEA were concerned about the diversion in the early years, before the traffic would have doubled. Mr Gardiner put it to Mr Wheatcroft that BEA would not be able to start operations before 1963, by which time the traffic would have substantially increased, and BUA's initial frequency would not be the maximum asked for. Mr Wheatcroft said that would aggravate the problem as BEA would have to provide capacity for the full British share of traffic up to that time.

Mr Ashton Hill, for Cunard Eagle Airways, was the next to cross-examine Mr Wheatcroft, and began by asking whether the witness could not be said to have changed his views on pools since 1956. Mr Wheatcroft said that he had modified them, but not substantially. Mr Ashton Hill suggested that the witness had had very definite ideas on the subject in 1956 (with which Mr Wheatcroft agreed) and quoted passages from Mr Wheatcroft's book on the general undesirability of pools and the rarity of the circumstances in which they were desirable. Mr Wheatcroft emphasized that circumstances had changed due to the protectionist attitude of various foreign governments. Mr Ashton Hill also suggested that statistics used by BEA applied only to conditions of normal growth of passenger traffic and could be misleading in abnormal circumstances.

The Board questioned Mr Wheatcroft about the applicability of his Canadian study to European operations and suggested various factors which made the cases dissimilar. Mr Wheatcroft said that he thought the two cases were broadly comparable. Mr Marking then re-examined and asked what his witness felt about suggestions that cross-subsidization of unremunerative by profitable services was undesirable. Mr Wheatcroft replied that this was still his opinion, but such cross-subsidization was sometimes necessary.

The next witness for BEA was Mr W. R. Collingwood, who, after confirming his special responsibility for advising BEA on agreements and pools, was asked by Mr Marking to outline the circumstances which had led to the pooling agreements. Mr Collingwood explained that BEA had, in effect, two problems: to deal, on the one hand, with those countries with powerful airlines and, on the other, with countries whose airlines were weak but who protected the interests of these airlines against competition. BEA had dealt with the first problem by trying to match the strength of the powerful airlines despite an initial inferiority in equipment; they had also had to contend with the results



BEA's domestic-trunk seating capacity, past and future

of these operators subsidizing the European extensions of their long-distance routes in order to attract traffic to the latter. To achieve this BEA had entered into commercial agreements with the foreign airlines.

The second problem arose because bilateral government agreements provided for the protection of the small foreign airlines and obstructed the growth of BEA. This problem had also been overcome by commercial agreements which had allowed BEA to build up a major share of the traffic between the UK and the countries concerned in return for a small degree of protection. These agreements had not been commercially expensive to BEA; they protected BEA's interests and provided for compensation for disparity of traffic carried. The Government had supported pooling agreements, but liberalization of traffic rights was sought.

Asked about the general principle of pools, Mr Collingwood said that they were aimed at improving the service offered to the public and eliminating waste, by providing a good spread of flight schedules at a reasonable frequency and sharing services.

Mr Marking then asked his witness's opinion of the possible effects of the introduction of a second British carrier on European routes. Mr Collingwood said that unity of effort and efficient negotiation of agreements would be prejudiced. He referred to Sir George Cribbett's evidence on the allocation of fixed shares of traffic under bilateral agreements, which would mean a loss of traffic to BEA. It was even possible that the British carrier or carriers might be restricted to the share provided for in bilateral agreements instead of the rather more generous share which BEA had succeeded in negotiating under commercial agreements.

Pooling agreements did not eliminate competition; this was ensured by other operators and by the mutual competition between the parties to the agreements in view of six-monthly re-negotiation of terms.

BEA had bought Comets to meet competition from Air France Caravelles.

Pools, said Mr Collingwood, had benefited the public through (1) joint scheduling with a good distribution of flights through the day; (2) promoting a more rapid growth of business; (3) reduction in operating costs ensured by elimination of excessive frequencies and wasteful competition; (4) low off-peak fares which the reduced operating costs made possible. Dual participation would adversely affect the conditions which facilitated these benefits and would damage BEA's position as the leading airline in Europe.

Cross-examining on behalf of BUA, Mr Gardiner suggested that Mr Collingwood's opinions were contrary to those which had been expressed by Mr Masefield, who had considered pools to be a grave social and economic danger. Mr Gardiner suggested that on the service to Madeira it would be better to carry all the traffic instead of entering into a pooling agreement with TAP. Could not the bilateral agreement be terminated at 12 months' notice and re-negotiated on more favourable terms? Mr Collingwood said there was a good deal in favour of doing this, but apparently the Government did not think so.

Mr Ashton Hill, cross-examining for Cunard Eagle, referred to the claim that pools helped by ensuring good arrangement of schedules through the day, and asked whether Mr Collingwood did not agree with the statement in Mr Wheatcroft's book that scheduling agreements could be negotiated without entering into pooling agreements. Mr Collingwood said that as far as he was concerned, Mr Wheatcroft was just another author expressing an opinion.

Mr Porter, for Tradair, asked whether Mr Collingwood would agree that Tradair's proposals would not affect the bilateral agreements and BEA's pooling agreements. Mr Collingwood replied that he could not agree with this.

The Board questioned Mr Collingwood on the meaning of clauses in the typical pooling agreement put in by BEA controlling the sharing of revenue.

Mr J. L. Grumbridge, general manager, commercial, of BEA, next gave evidence and was asked by Mr Marking to state his commercial and sales objectives, and how he set about achieving them. Mr Grumbridge said it was BEA's policy to reduce fares. The policy was to make reductions, not "across the board," but in such a way as to attract traffic to off-peak periods by fare differentials. Low fares introduced were planned to attract new traffic without dilution of existing sources of revenue. Additional revenue from new low-fare traffic could also facilitate overall fare reductions. Asked how granting of the applications would make it impossible for BEA to continue their present fare policy, he said that wasteful duplication of services and diversion of traffic would lead to lower load factors and would increase costs.

Mr Grumbridge explained that fare revisions had to be unanimously agreed by IATA conferences. BEA's bargaining position in these negotiations was strengthened by their commercial agreements with other operators.

The Package Tour Business

With reference to "misleading statements made about ITX fares," he said that the airlines had, by special discounts, and by IT fares, encouraged agents to sell package tours. By 1957 this business had been worth more than £1 million. To meet a fall in business in 1958, midweek night fares had been introduced, with great success. Mr Grumbridge said that BEA might lose the pre-eminent position they had established in the negotiation of differential fares with foreign operators if they had first to negotiate with a second British operator. Duplication of BEA's service by a second operator would lead to concentration on the most profitable hours of operation, with a consequent poor service. Vanguards reduced costs and provided increased capacity, but splitting the traffic with another operator would make it necessary to reduce frequency. This would result in poorer utilization and uneconomical operation, making it impossible to pursue the policy of reducing fares.

The Board asked Mr Grumbridge to elaborate on the difficulties which he thought a second operator might cause in fare negotiations at IATA. He explained that differences in policy between the two operators might confuse negotiations and prevent presentation of an agreed British case.

Cross-examining on behalf of BUA, Mr Gardiner asked the meaning of the phrase "across the board." Mr Grumbridge explained that it meant all fares in a particular group or class. Mr Gardiner contrasted the rise in European average fares with reductions on the North Atlantic and asked whether there had not been a greater decrease in the lowest fares on the Atlantic than in Europe. Mr Grumbridge said that the lowest fares on the Atlantic applied only to propeller services, about six per cent of the traffic. Asked what were the BEA fares which would be affected by the five per cent "across the board" increase proposed for Europe this winter, he said that almost all fares would be raised, the only exceptions being a few recently reviewed, and those to certain Middle East destinations. He agreed that this did not accord with a policy of reducing fares, but said that it was not possible to disregard rising costs.

Mr Ashton Hill, cross-examining for Cunard Eagle, asked whether Mr Grumbridge was aware that Cunard Eagle were already members of IATA and represented in Traffic Conference 2. Witness replied that this had not yet led to complications only because they were not operating parallel routes. Asked whether he agreed with Mr Wheatcroft's view that the only objection to the applications for domestic routes was that they had come at the wrong time, Mr Grumbridge said "Maybe."

The final stages of Mr Ashton Hill's cross-examination of Mr Grumbridge concerned the application of IT and ITX fares on BEA services. He suggested that charter flights offered certain advantages over bookings on BEA services at IT rates, such as group bookings in hotels, with which the witness agreed. Mr Ashton Hill then said that when charter figures rose astronomically in 1957-58 BEA met this development by the introduction, in 1959, of ITX fares, which were much lower than those previously charged and were applied to single seats on BEA schedules. He suggested that, in view of the fact that the independents could not do the same, since they were not allowed to operate scheduled services, this was unfair competition. Mr Grumbridge did not agree.

Mr J. Gilbert, commercial planning manager of BEA, was next called to give evidence in support of the corporation's general objections. Mr Marking asked his witness questions regarding the figures from BUA tables which had been queried by a member of the Board. Mr Gilbert said that Mr Whybrow of BUA had, as he was entitled to do, elected to use the figures from BUA table M.18, which better supported his company's case. While Mr Gilbert did not accept that the BUA figures were correct they could be used to illustrate his own evidence. He then introduced document BEA 61.

This document compared figures, given by BUA in evidence, for the proportion of total traffic which they would expect to carry in 1965 (based on table BUA 1 M.18) with figures based on table BUA 1 M.19, which BEA considered more appropriate, and with corrected figures prepared by BEA for both 1963 and 1965. Figures for 1963 had been given because BUA would not be providing any capacity until that year. BEA must, therefore, provide capacity for all the British share of the traffic until 1962—or possibly until 1963, depending on the result of the applications and how soon BUA would be able to start operations if licences were granted. A load factor of 60 per cent had been assumed by BEA, instead of the 50 per cent taken by BUA, because 60 per cent was the minimum required for economic operation; it was also the minimum typical load factor in Europe. Figures had been based on 56 per cent of the total traffic instead of the whole of the traffic (which had been taken as a base by BUA) because BEA had carried 56 per cent of the total traffic in 1960 and might expect to carry the same proportion in future, as the sole British operator. Any traffic carried by BUA would be diverted from BEA.

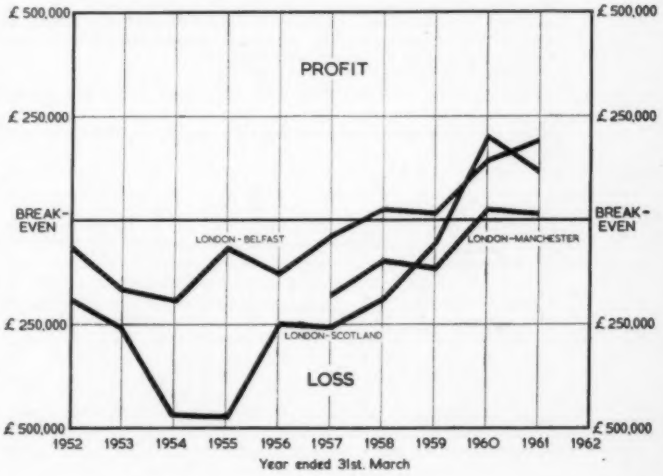
BUA's Estimated Shares

BEA's calculations based on these corrections showed that BUA's capacity expressed as a percentage of the total traffic would be 15.8 per cent in 1963 and 13.2 per cent in 1965. The figure put forward by BUA had been 10 per cent in 1965. The traffic BUA could expect to carry, expressed as a percentage of the total traffic available to British carriers, became 28.2 per cent in 1963 and 23.6 per cent in 1965, compared with BUA's figure of 5 per cent in 1965. Asked to explain the startling difference in the figures, Mr Gilbert said that the percentages calculated by BEA had been based on the growth 1962-63 and 1962-65, i.e. growth since the year before BUA would start providing capacity.

If BUA achieved a load factor of only 30 per cent in 1963 the diversion from BEA would still represent 97.7 per cent of the growth of BEA's share of the traffic. All the calculations were based on the assumption that BUA would use 64-seat Viscount or BAC One-Eleven aircraft. If they used larger aircraft, such as the Britannia, the diversion would be greater. The percentages were based on year-round operations, but the diversion would be increased in the trough periods.

Mr Gilbert was then cross-examined by Mr Gardiner on behalf of BUA. Mr Gardiner put questions about various factors included in, or excluded from, BEA's statistics and forward estimates, suggesting, in general, that BEA's figures were no more reliable than those of BUA with which the witness had compared them. The outcome of these exchanges was that BEA undertook to produce further figures as soon as possible, although this would not be before the beginning of the following week. Mr Gardiner suggested that BEA figures which had been produced in evidence were misleading because they were based on aircraft of a capacity which BUA would not use, in a year when BUA would not be operating, and on the assumption that all BUA traffic would be diverted from BEA. Mr Gilbert disagreed with the suggestion that the BEA figures were misleading. Although BUA might not be using BAC One-Elevens in 1963 they could be using Viscounts and Britannias. The capacity of these would average approximately the 64 seats of the One-Elevens. He confirmed his belief that all BUA traffic would come from BEA and, when counsel for BUA suggested that this

BEA's domestic-trunk profit/loss achievement



AIR COMMERCE . . .

was contrary to the evidence of the last ten years, said that he thought that BUA, being based in the UK, would probably operate on a similar pattern of routes and timings to those of BEA. BUA, with its headquarters in the UK, would probably concentrate even more than BEA on the UK market, rather than on traffic originating abroad. Therefore, quite apart from any consideration of bilateral agreements, BUA would be more likely to divert traffic from BEA than from other carriers.

Mr Gardiner suggested that BUA would be very willing to co-operate with BEA in arranging that the two daily flights of BUA to Paris, for instance, would be fitted into the pattern of 20 flights per day operated by BEA, or the 40 daily flights operated jointly by BEA and Air France on the Paris route. Mr Gilbert said that, in brutal truth, BEA would be operating only seven Vanguards daily to Paris next winter. He added that he did not believe the BUA would create any new traffic unless they could offer the public some new facility or more of an existing but inadequate one, and there had been no evidence that they would be able to do so. At peak periods, extra flights could be added to schedules by BEA, but the effect of BUA would only be to reduce the load factors in the troughs.

Mr Gardiner suggested that the independents had always created new demands by going after traffic in which BEA was not interested. Mr Gilbert replied that, as far as ITX flights and air trooping were concerned, it was well known that Government control of BEA's aircraft procurement had always prevented the corporation having aircraft available for work of this kind.

Mr Gardiner asked whether Mr Gilbert was aware that BUA had a large sum of money invested in plans to build a hotel on the island of Madeira, and were considering undertaking further expenditure to provide a modern ferry service to Funchal? Mr Gilbert said that he had not been aware of these plans, but BEA had their own plans for improving amenities, including the provision of a helicopter service.

Initial Load Factors

Mr Gardiner made another brief attack on BEA. 61, asking why a 60 per cent load factor had been used in estimating the diversion which would result from BUA's services; he commented that no one outside a lunatic asylum would expect 60 per cent within the first three years. He then said that he would leave this subject until BEA had produced the revised figures and estimates. He asked that these should include 1965 estimates for the routes applied for by BUA. The Board pointed out that the only BEA figures they had for estimated growth of traffic did not cover all traffic, but only BEA's, nor did they cover the full year. Mr Gardiner asked that the new figures should be based on the calendar year, and on passenger-mile, not passenger, totals to permit comparison with BUA's figures.

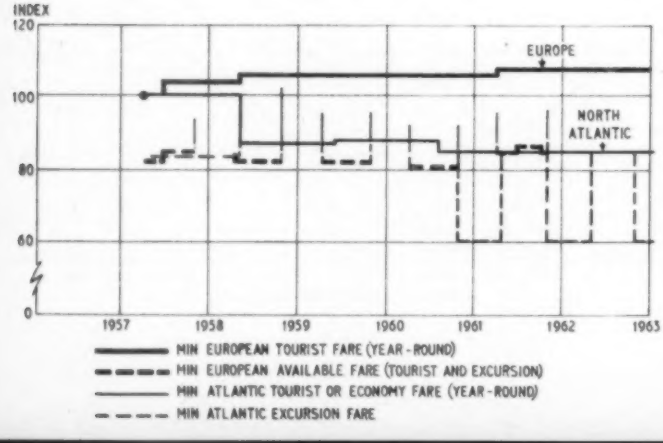
Mr Ashton Hill, for Cunard Eagle, asked that the new figures from BEA should show routes separately. He then started his cross-examination of Mr Gilbert. He asked the witness whether his suggestion that BUA's traffic would come principally from the UK applied also to Cunard Eagle. Mr Gilbert said that it did. Mr Ashton Hill then asked Mr Gilbert to comment on the chart (CEA. 4) in which Cunard Eagle had projected the BEA chart No 8 (showing the proportions of European traffic carried by BEA and other operators) up to 1965, and had taken Cunard Eagle's estimated three per cent of the traffic from the column representing the other operators instead of from BEA. Mr Gilbert said that, apart from the BEA figures quoted, he disagreed with it entirely. It did not cover all the applications, only those from Cunard Eagle; also, he did not agree that Cunard Eagle would take their traffic from other operators. He could not elaborate on this point without the promised details of Cunard Eagle's operating plans.

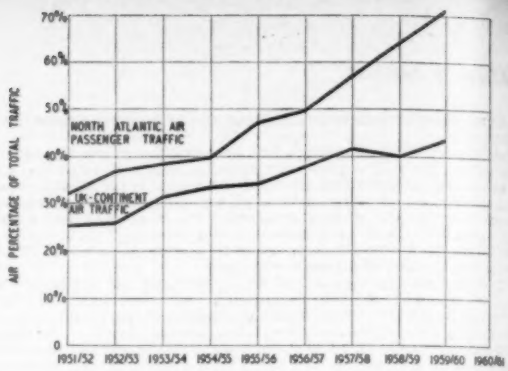
Mr Porter cross-examined Mr Gilbert on behalf of Tradair. Referring to Mr Gilbert's reply to Mr Gardiner, in which he said that the independents would not create any new traffic unless they could offer the public some new facility, or more of an existing but inadequate facility, Mr Porter asked whether Mr Gilbert would agree that BEA had not filled the demand for block booking facilities. Mr Gilbert said he did not agree; BEA had had numbers of blocks of seats returned by agents to whom they had been allocated. Mr Porter suggested that either the seats had been allocated in blocks too small to be of practical value, or they had been allocated on days which could not be fitted in with inclusive tour arrangements. Mr Gilbert disagreed.

Mr Marking re-examined his witness.

Asked to explain his statement that the independents might increase

BUA's telling comparison between European and N. Atlantic fare levels





North Atlantic and European air penetration of the market: a BUA chart

traffic by providing new facilities or more of existing but inadequate facilities, Mr Gilbert said that there could be occasions, on peak days of peak traffic periods, when another operator might accommodate traffic which could not otherwise be carried. He thought that this could only be done most uneconomically, however. Mr Marking produced a copy of *Flight* for February 10, 1961, and, with reference to the use of a 60 per cent load factor in estimating the diversion which would be produced by BUA, asked whether Mr Gilbert had read a letter written to the Editor by Mr Laker. Counsel for BUA protested that this was most improper; this copy of *Flight* had not been produced in evidence, nor had Mr Laker been questioned about his letter when he was cross-examined by Mr Marking. Mr Marking was allowed to read an excerpt from which it appeared that Mr Laker had himself used a load factor of 60 per cent in estimating the traffic which BUA might carry. Mr Marking asked whether Mr Gilbert considered that this justified the use by BEA of the same load factor in estimating BUA's future traffic. Mr Gilbert said he thought that it did.

Mr P. Brooks, fleet planning manager, BEA, formerly assistant to the chief executive and to the chairman, was the next BEA witness. Asked by Mr Marking to explain how diversion of traffic would cause underemployment of aircraft and consequent redundancies in aircraft orders, he introduced document BEA. 62, a chart of BEA actual and forecast traffic from 1948 to 1968. The rate of growth on which this chart was based decreased from 17 per cent over the next four years to 11 per cent in 1966. These estimates were those used, after scrutiny by the Ministry, as a basis for ordering aircraft.

Accuracy of BEA's Forecasts

As an example of their accuracy in the past, Mr Brooks mentioned that estimates prepared in 1957 to justify ordering new jet aircraft had given load ton-mile figures for 1960 which had proved to be only one per cent high, and capacity ton-mile figures which had proved to be exactly right.

Mr Brooks introduced document BEA. 63, a chart on which were plotted BEA's passenger miles up to 1965-66, based on three assumptions: (1) That BEA's planned developments continued unchanged; (2) that BEA's planned new routes were not approved; and (3) that all the applications from independents for scheduled services were approved.

The difference between (1) and (2) was equivalent to three Tridents, and the gap between (2) and (3) was equivalent to a further 13 Tridents. The total difference, equivalent to 16 Tridents, would represent severe damage to BEA's financial results brought about by under-utilization of aircraft, the BEA maintenance base and other assets.

Mr Brooks was questioned about Mr Laker's examination by BUA counsel on operating costs, and the suggestion that BUA operated Viscounts more economically than BEA (£192 per hour against £232). Witness said that the comparison was highly misleading because: (1) BEA Viscounts were mixed-class aircraft—this added £5 per hour to the operating cost; (2) BEA's costs included interest on capital at £8 per hour; (3) BEA's operations on short-haul routes added about £10 per hour over BUA's longer haul route costs. In addition, the cost of BEA's operation of Viscount 806s in 1960-61 had been only £205 per hour. Adjustment of this figure in the same way gave a lower cost than BUA's £192. Mr Laker had suggested that new types would reduce specific costs. BEA's costs would be similarly reduced; the Trident would cost no more than the BAC One-Eleven on routes up to 600 miles, and less on longer routes. On a cost per seat-mile basis, the Vanguard was 12-17 per cent cheaper than these jets.

Mr Brooks later volunteered that he had been mistaken in assuming that BUA's Viscount costs did not include interest, but he confirmed that the evidence he had given showed there was no significant difference between the operating costs of BEA and BUA. The Trident would be comparable to the BAC One-Eleven, and the Vanguard to both aircraft.

Mr Gardiner, cross-examining on behalf of BUA, questioned Mr Brooks about the method used by BEA to compute the landing cost factor in working out operating costs and pointed out that BUA's figure had been calculated on the basis of a stage distance of 400 miles. He suggested that BEA's comparison was wrong on three counts: the inclusion (or exclusion) of interest, stage length and handling costs, in which respect the differential was excessive, if admissible at all. Witness did not agree. Counsel for BUA went on to suggest that the reduced cost of operating BEA's Viscounts in 1960-61 provided a good reason to reduce fares. Witness said that would be the case if the whole fleet were Viscount 806s. Mr Gardiner asked further questions about the cost of operating Tridents and Vanguards, claimed to be cheaper than Viscounts, and asked why BEA supported a five per cent "across the board" fare increase. Witness said this was not the general policy of BEA.

[To be continued.

Seen at Lod Airport, Tel Aviv, this El Al Boeing 707 crew had just set up a new record for the New York – Tel Aviv route, the longest scheduled non-stop run of any airline in the world. Captain Tom Jones, El Al's superintendent of flight operations, who captained the flight, is fourth from the right

BRITAIN'S BILATERAL AGREEMENTS

IN recent years the bilateral-agreement negotiators in the Ministry of Aviation have left largely to BEA and BOAC the job of striking better bargains for British air transport. The corporations have done this by negotiating pooling agreements—agreements which (despite what BEA told the Air Transport Licensing Board recently) the Ministry does not even see.

If the Licensing Board does decide to grant independent licences, hard political bargaining lies ahead, and the Ministry must accept responsibility for the powers that it claims, and which were denied the Board.

There would be cause for disquiet even if the Ministry does sit up, switch off the corporations' pooling autopilots, and take over the controls. The Ministry has a vested interest in BOAC and BEA, so it need not try hard to win for the independents the traffic rights that are needed to consummate any licence that the Board may grant. The Ministry's power over traffic rights, which we wanted the Board to share, can make a mockery of the whole licensing system.

Somebody must draw attention to the muddle that exists, and that body is the Board. The case law that the Board uttered when it granted Cunard Eagle's Atlantic licence was excellent—particularly in its disposal of that abstract art form "material diversion." Let it next draw attention to the need for the Minister to pull up his bilateral socks. The Minister will not be cross; his predecessor is on record as having said that the Board is independent. This being so, the Board can say what it thinks. And if it thinks—as it surely must if it decides to grant any independent licence—that bilaterals can be used to defeat the Board's purpose, it must say so, in public.

BOAC 1960-61

TODAY, July 27, Sir Matthew Slattery, chairman of BOAC, is due to present the corporation's report and accounts for the year ending March 31, 1961, a year which is expected to show a loss of about £1.7m. On operations alone, provisional figures issued in May showed a record operating profit of some £4¼m, but interest payments reduced this to only about £100,000 and the losses of BOAC Associated Companies were up by about £700,000 to £1.8m.

Big increases in capacity, especially on the western routes, combined with a shortfall in traffic on western routes, caused a drop in load factor of two percentage points to 55.5. A total of 790,718 passengers was carried on all services by BOAC. We hope to publish reviews of the report and accounts in subsequent issues.

TO HEAR THE APPEAL

IN answer to a question from Mr Chetwynd, Mr Geoffrey Rippon, PPS to the Minister of Aviation, revealed in the Commons last week that Sir Fred Pritchard, a retired High Court judge, has consented to hear BOAC's appeal against the licensing of Cunard Eagle on the North Atlantic route. "Under the procedural rules the appeal cannot be heard before the middle of August," said Mr Rippon. "A date will be fixed which is convenient to the commissioner and to the parties, but it may not be heard until the beginning of September. The appeal will be heard in public."

INCLUSIVE-TOUR MARATHON

WHATEVER else might be said about the Air Transport Licensing Board, it cannot be charged with any lack of what Sir Miles Thomas used to call speed-of-decision. The speed with which the North Atlantic Service Case (as the CAB would have called it) was decided compares with the time taken over some of the CAB's own route and fare cases: 4½ years for the General Passenger Fare Investigation, to take an extreme example, and three years for the Domestic Cargo-Mail Service Case, which is still to be decided.

Now, faced with a truly daunting volume of inclusive tour applications for the 1962 summer, the Board has got its IT hearing organized to a high degree, even to specifying where applicants and objectors should sit.

These IT applications will begin to be heard on Tuesday, August 15, continuing until Friday, August 18; thereafter hearings will probably be held on four days of each week, usually Monday to Thursday. As with the recent winter IT hearings, the Board will sit in two panels, one meeting in the mornings and the other in the afternoons. The procedure of application, objection and cross-examination has also been outlined in detail in *Civil Aviation Licensing Notice* No 31.

THE STRIKERS GO BACK

THE fortnight-old unofficial strike of BOAC maintenance men ended on July 20 when strikers voted to resume work. This was only two days after a mass meeting had decided to reject a five-point proposal from the National Joint Council for Civil Air Transport for settlement of the strike; among the points was an unqualified BOAC undertaking that no one would be adversely affected by the reorganization of the supervisory grades. The strikers agreed to go back on the terms rejected at the previous mass meeting, and a six-man committee will now investigate their complaints about the operation of BOAC's new supervisory scheme already introduced in some of the corporation's shops.

The sudden change of heart which ended the strike was, it seems, based on the prospect of a Ministry of Labour court of enquiry into the strike, similar to Professor Jack's enquiry into the Comet strike nearly three years ago. None of the strike leaders wanted this, because it seems to be the general opinion that Government-appointed courts of inquiry "always throw mud on the trade union movement." The strike, which has cost BOAC an estimated £1.5m, was characterized by inter-union rivalry; Sir Matthew Slattery, in an interview with the *Daily Mail*, described the strike as a dispute between the ETU and ASSET (the Association of Supervisory Staffs, Executives and Technicians). "ASSET has got a certain amount of kudos from its members, having been regraded with an extra 42s or so a week. This has increased ASSET's prestige," said Sir Matthew. "The ETU is upset—particularly as when its men are promoted to supervisory jobs they tend to go over to ASSET. One union leader said last week they regarded ASSET as interlopers." BOAC itself was criticized by Mr Jim Matthews, national industrial officer of the general and municipal workers, for its handling of the dispute; "The corporation has been among the most ham-handed employers I have ever met on this issue. Mind you, I think some of our own people are ham-handed as well."

The supervisory scheme that caused all the trouble was the last stage in the reorganization of the engineering department, which has been going on for two years or more.

ACCIDENTS POSTSCRIPT

FOLLOWING the crash-landing of a United DC-8 at Denver on July 11, and an incident on the following day in which an Eastern DC-8 swung off the runway on landing at Miami and blew out all the main undercarriage tyres, the FAA sent a telegram to all DC-8 operators announcing changes in the procedure for emergency operation of the DC-8 hydraulic system. This requires the pilot to conserve as much hydraulic accumulator pressure as possible during emergency free-fall lowering of the landing gear. The FAA also draws attention to the possibility of an inadvertent opening of the DC-8's thrust reversers after the pilot has selected reverse; this could lead to loss of control.

Ceteka, the official Czech news agency, has issued an unusually frank statement on the CSA Il-18 crash near Casablanca: "Legitimate surprise has been aroused by the fact that two aircraft of the Czechoslovak Airlines, which have proven their reliability on many air routes throughout the world, crashed within the short period of four months on the route between Prague and Bamako, on which many difficulties had to be overcome from its very inception."

It is not clear from this whether the "difficulties" are diplomatic (i.e., traffic rights) or operational; but by linking the CSA Il-18 crash near Nuremberg with that at Casablanca, the official statement implies that the causes of both accidents had something in common. The Nuremberg disaster was due to some sort of in-flight explosion (the Czech news agency has hinted at the possibility of sabotage), while the Casablanca crash seems to have been caused at least partly by unfamiliarity with the alternates.

Understandably jubilant, these are the crew members of the Tu-114 which, as recorded last week, uplifted a payload of more than 66,000lb to a height of more than 41,000ft. The flight (which is being claimed as a record in the 30,000kg class) took place on July 12 from Moscow Vnukovo. From left to right: Capt I. Suhomilin, pilot; Capt P. Soldatov; engineer V. Mogdanov; flight engineer S. Petrakov; radio operator A. Anikin; and navigator N. Mosov

AIR COMMERCE . . .

MR PATTERSON ON SIZE

MR W. A. PATTERSON, president of United Air Lines, has some interesting things to say about the merger with Capital in the July issue of *Mainliner*, United's house magazine. The merger story began, he says, in June 1960 when Capital representatives approached United to ask whether they would be interested in exploring merger possibilities; United was not the only airline so approached. The final merger plan was approved by United's board on April 4, 1961, with only minor changes. Mr Patterson points out that United's business still peaks in the summer and valleys in the winter, and access to Capital's southern and eastern routes should increase utilization and improve United's traffic.

The Viscount, "though not an effective competitor on longer routes, is a proven and popular airplane," says Mr Patterson, "and our flight people feel we can operate it profitably on short route segments, at least until we are able to replace it with pure jets such as the Boeing 727. In some cases we will place Jet Mainliners on former Capital routes at once. We see many opportunities to improve service to most new cities on our enlarged system.

"We are frequently asked to comment on the fact that this merger makes United the nation's largest airline. To us, this is not necessarily a blessing, if true. We have watched the rapid growth of our industry with a wary eye. Size tends to destroy some of the personal relations with customers which characterized air transportation from the start. . . . It is our earnest hope that we will retain that old desire to serve each individual passenger.

A MILLION ARGOSY MILES

MORE than 5,000hr have now been flown by the Argosy since the prototype's maiden flight in January 1959. All of the first batch of ten, built as a £13m private venture, have been delivered or are due for delivery to Riddle Airlines and BEA. Six of these were used by Armstrong Whitworth on development flying and logged a total of 2,280hr in 1,434 flights involving 1,951 landings.

The 5,000hr includes development flying on the Argosy C. Mk 1 for Transport Command and Riddle's operational flying. Riddle's first three aircraft logged almost as many hours in three months' operational flying as the total flown during development flying. A successful solution has been found to skin-cracking problems in the tail area (discovered by Riddle). The first prototype has been used for trials at a maximum landing weight of 84,000lb compared with the certificated weight of 80,000lb, and an amendment to the type certificate to cover the increase is now awaited.

Effort will now be concentrated on development and production test flying of Argosy C. Mk 1s until the Argosy 200 with the fail-safe box-spar wing and other improvements begins flying in 1963. Riddle has an option on eight more Argosies.

TURNHOUSE REOPENS

EDINBURGH'S Turnhouse Airport is to reopen on August 1 and East Fortune, used for scheduled services while Turnhouse has been closed, will no longer be used by the airlines. Turnhouse was closed on April 5, since when work has been in hand on runway and apron strengthening, construction of a new taxiway link to the main runway, a new Customs block, and alterations to the terminal.

The Customs block will not be ready when the airport reopens, but together with alterations to the terminal it will provide almost double the accommodation for passengers in the main concourse. Visual glide-path indicators have been installed and the existing ILS has been replaced by a new one. To improve the controllers' field of vision, a Dorval-type control tower is being installed on top of the existing tower, and work on the erection of this "glasshouse" is expected to start shortly after Turnhouse reopens. The car park has been greatly enlarged to provide accommodation for 250 cars. Total cost of Turnhouse's modernization is about £200,000.

FALCON AIRWAYS v THE MINISTRY

NEVER has the Ministry of Aviation referred in public to the safety standards of a particular airline operator. The Ministry statement issued on July 18 sets a precedent:—

"Falcon Airways Limited yesterday made a further request to the Ministry for permission under Article 68 of the Air Navigation Order, 1960, to use an Austrian registered Constellation aircraft, OE-IFA, for flights from Gatwick for inclusive tours during the coming weekend. The Ministry received a similar request for the use of OE-IFA on Friday last, July 14, for flights from Gatwick last weekend.

"Falcon Airways have no aircraft available. Their Constellation G-AMUP is undergoing modification for the installation of fire protection in accordance with the Air Registration Board's requirements first notified to them in January 1961. Their Constellation G-AHEL was transferred on July 13 to Trans-European Airways Limited. Their Constellation G-AHEJ has no certificate of airworthiness.

"According to information from the Austrian authorities, the aircraft OE-IFA for which permission was sought had been placed on the Austrian register on June 27, Aero Transport Flugbetriebsgesellschaft being the registered operator. It had been supplied by Capt Kozubski, the managing director of Falcon Airways, who were registered as the owners.

"It is understood from the Austrian authorities that Capt Kozubski would pilot the aircraft.

"Under the Air Navigation Order, 1960, there is discretion to grant or refuse permission for foreign-registered aircraft to pick up or set down passengers for hire or reward in this country. In the exercise of this discretion, the Ministry has formed the view that the connection between Falcon Airways, Capt Kozubski, and the operation of this aircraft were so close that the permission ought to be withheld on the ground that the use of this aircraft in these circumstances would enable it to be flown virtually by a British undertaking, and carrying British passengers, without regard to many of the safety requirements of the Air Navigation Order, 1960, and particularly the safety conditions attached to the Air Operator's Certificate held by Falcon Airways. Falcon Airways have been so informed.

"Falcon Airways hold an Air Operator's Certificate limiting their operations to an area covering broadly Europe and the Mediterranean, and if they complied with the conditions of their certificate and the requirements of the Air Navigation Order and Regulations there would be no objection to their carrying out these flights with British-registered aircraft. The flight time limitations of the Order governing pilots' hours are particularly important.

"Falcon Airways gave notice of appeal against the limitation on their Certificate. The appeal was due to be heard on July 12, by Mr J. Roland Adams, QC, but on July 7 Falcon Airways wrote: 'Due to changes within the Company, which have taken effect since the date of our Notice of Appeal, we now wish to advise you that it is our desire to withdraw the said Appeal.' "

Note: Article 68 of the Air Navigation Order, 1960, reads as follows: "An aircraft registered in a Contracting State other than the United Kingdom, or in a foreign country, shall not take on board or discharge any passengers or cargo in the United Kingdom, being passengers or cargo carried or to be carried for hire or reward, except with the permission of the Minister granted under this Article to the operator or the charterer of the aircraft or to the Government of the country in which the aircraft is registered, and in accordance with any conditions to which such permission may be subject."

Obviously, the important question is: What *are* the safety conditions attached to Falcon Airways air operator's certificate which might have been, in the Ministry's view, disregarded?

Every AOC issued to British operators by the Ministry's director of aviation safety (Mr W. E. B. Griffiths) has special conditions, and so far as the Ministry is concerned these conditions are secret.

Mr Frederick Beezley, assistant managing director of Falcon, last week told *Flight* the special conditions attached to his company's AOC. These are: (1) That Falcon should employ a particular check captain [Capt L. Chegwidden]; (2) That 14 days' notice be given if the company abolishes the positions of chief pilot or operations manager. Mr Beezley said there had been no changes in these positions, and therefore the question of whether these conditions had been met did not arise.

Asked whether there were any other special conditions attached to Falcon's AOC, Mr Beezley said: "If ever you find out what are the special conditions to which the Ministry are directing their minds, I would be delighted to know."

Previously, Mr Beezley had been quoted in a newspaper as follows: "I think certain officials of the Ministry of Aviation have a personal dislike of Capt Kozubski and myself."

Though not quite as large as the exceptional windows of the Viscount, those of the BAC One-Eleven are more closely pitched. They are of VC10 type, and are elliptical with an interior picture frame. This picture was recently taken at Weybridge in the mock-up

BACKWARD THINKING IN AMERICA

THE Americans, who have contributed so much towards the evolution of the modern airliner, and of air transport, are still non-committal on the subject of rear-facing seats. The FAA is studying a possible regulation making aft-facing seats compulsory, but a recent FAA conference revealed widely differing views on the subject—as usually happens when this issue is discussed in Europe.

One airline official went so far as to challenge a survey which showed that only three per cent of 10,000 military passengers objected to rear-facing seats on the grounds that the survey was "loaded" because it started with the line "In view of the safety advantages of aft-facing seats, would you object to . . ." And a Lockheed spokesman said studies showed that seat reversal would add from five to ten pounds of weight per passenger, because a rear-facing seat would need stronger floor attachments, and that over ten years this extra weight would add nearly £1m to the operating costs of each aircraft. This statement is all the more surprising in view of the widespread use of rear-facing seats in military Super Constellations and other US Air Force types. It is an argument that could be applied to life-belts or fire-fighting equipment.

In America as in this country military users of air transport favour facing backwards. Col John Stapp, well known for his pioneer work in riding rocket sleds to test acceleration and deceleration forces, favoured rear-facing seats and said that the Federal Government should subsidize their cost, while the US Armed Forces Institute of Pathology urged the making of such seats compulsory. Less decisive attitudes were expressed by other bodies: the Air Transportation Association said that all available evidence showed that rear-facing seats could be more dangerous than forward-facing seats in some crashes (surely rather obvious?); NASA's opinion was that much had to be done to increase the chances of surviving a crash, but that seat direction did not appear to be a major solution. Likewise non-committal, the Aerospace Industries Association, while recommending further research into the question, doubted if rear-facing seats offered any real increase in safety. The ALPA's view was that even if rear-facing seats were safer, it would be better to spend the money on improving airports, as that was where most survivable crashes occurred.

It was generally agreed that safety could be improved by such means as removing hard trays from seat backs; but the tendency to face away from the rear-facing issue was underlined by the suggestions put forward that passengers might be induced to wear shoulder harnesses as well as seat belts.

An MEA Viscount is a regular sight at Gatwick nowadays, having been chartered for a month by Jersey Airlines for operation on the busy routes to Dinard, Jersey and Bournemouth. The aircraft is a 56-seater and is flown by MEA crew

1961 HALF-YEAR ACCIDENT RECORD

THIS year ought to show a rather better safety record than that of 1960, if the trend evident in the first six months of 1961 is maintained for the rest of the year. During this period there were 21 fatal accidents to civil transport aircraft on revenue flights, and 442 lives were lost; this compares with 23 accidents and 590 lives in the first six months of 1960.

Over 350 passengers and 90 crew members were killed in accidents up to the end of June 1961. There were three accidents involving big jets, compared with only one in the whole of last year (crew-training accidents and those involving non-fatal write-offs are not included). With the majority of jet deliveries now completed, a higher accident rate from this class of aircraft must obviously be expected; meanwhile, this year's accident rate so far follows last year's pattern in that widely-used piston-engined types are lost more often than jets and turboprops.

Only six accidents involved Latin-American carriers, or half the number in the corresponding period of last year. The table below includes non-scheduled as well as scheduled flights. It is not known in all cases which were scheduled flights, nor can some of the fatality figures be broken down into passengers and crew.

Date	Carrier	Aircraft	Location	Fatalities Pass.	Crew	Circumstances
Jan 2	CSA	11-14	Ruzyne	5	5	Hit HT wires on take-off
Jan 3	Finnair	DC-3	Vasa	22	3	Pilot error
Jan 18	Aeronaves de Mexico	DC-8	Idlewild	—	4	Crashed on take-off in snowstorm
Jan 19	Sabena	?	Kasenga	1	1	Unknown
Jan 22	Capitol Airways	C-46	Brookshire, Texas	—	2	Port engine caught fire; wing came off
Jan 24	Garuda Indonesian	DC-3	Mount Burangrang	16	5	Flew into mountain
Feb 3	Garuda Indonesian	DC-3	Between Surabaja and Balikpapan	21	5	Missing; presumed crashed
Feb 6	UAT	Max Holste Broussard	Grenoble	—	1	Unknown
Feb 15	Sabena	707-329	Near Melsbroek	61	11	Crashed on finals; runaway autopilot
March 10	LAV	DC-3	Near Carache, Venezuela	12 total		Flew into mountain
March 28	CSA	11-18	Near Nuremberg	52 total		Explosion in mid-air
April 4	LAN (Chile)	DC-3	In the Andes	20	4	Missing; presumed due to icing
April 20	Papuan Air Transport	Piaggio P. 166	Between Popondetta and Port Moresby	—	1	Unknown
April 20	Ethiopian	Bell 47J	175 miles n.w. of Addis Ababa	2	1	Unknown
May 10	Air France	L.1649A Starliner	Over the Sahara	69	9	Mid-air disintegration
May 12	LACSA (Costa Rica)	DC-3	Mount Arenal	—	2	Flew into mountain
May 24	TAA	DC-4	Near Brisbane	—	2	Unknown
May 30	VIASA	DC-8 (on lease from KLM)	Between Lisbon and the Azores	48	14	Unknown
June 12	KLM	Electra	Cairo	17	2	Hit hill on approach
June 18	Interocean	DC-4	Kano	—	1	Struck by lightning when landing
June 30	Transcontinental	C-46	Buenos Aires	21	2	Crashed on landing

Appointed an air traffic control assistant in the Nairobi flight information centre is Miss Deirdre Raymer, aged 18, who has a private pilot's licence. She is one of seven women in the centre appointed, to quote the East African Directorate of Civil Aviation, "to prevent controllers being distracted in their task"

AIR COMMERCE . . .

HOW NOT TO RUN AIRPORTS

AN independent authority to manage London's airports, differential landing fees at Heathrow for peak and off-peak periods, and a frequency rebate on landing fees at Gatwick are the most important recommendations of the Select Committee on Estimates' fifth report on airports, just published.

The unsatisfactory finances of London's airports, says the report, are chiefly the result of a failure, until recently, to regard them as commercial undertakings. The Committee say that they are particularly disturbed by the fact that "serious deficiencies in the machinery of financial control escaped the attention of the Treasury for so long, since it is not possible to control an undertaking such as London's airport with any effectiveness without adequate financial data."

An independent authority should be established to manage the airports, and it should present annual reports and accounts to Parliament. Being autonomous, it would be able to take decisions more quickly, would provide a more satisfactory career structure for its own specialized staff, and "would be able to react in a commercial manner to what is essentially a commercial situation."

The Treasury comes in for sharp criticism: "The Select Committee on Estimates pointed out in their report on Treasury control of expenditure in 1957-58 that one of the main objectives of any system of Treasury control should be to see that departments have a proper system of financial control within themselves. In their observations on this section of the report, the Treasury agreed that this was an important aspect of Treasury policy, and stated that the Treasury take a very close interest in the effectiveness of the spending department's own financial control and help to enhance it. Your committee criticize the Treasury for their failure to perceive this major deficiency in the financial control exercised over the airports in a period of *nearly ten years* in which costs were steadily rising and parliamentary concern was being expressed about the financial condition of the airports." The Committee described airport management as, in the main, conscientious and competent.

The Ministry had calculated that if landing fees had not been increased by a further 33 per cent in April 1961, London's airports would not have achieved a net profit before 1970. The Ministry now forecast a net loss of £1.2m in 1961-62 and a small net profit of £140,000 in 1963-64 increasing to an estimated net profit of approximately £3.6m in 1970-71. Steps have been taken to decentralize the costing and accounting system. "Your Committee believe that the Ministry are now working on the right lines, and are conscious of the urgent necessity for greatly improved costing facilities at the airports. It is unfortunate that such a conspicuous defect in the management system was not appreciated at an earlier stage."

Among the Committee's other recommendations are that urgent consideration should be given to the expansion of airspace available in the London terminal area for civil flying; unified civil and military air traffic control; reduction of the 100 per cent surcharge on landing fees payable for aircraft landing after intercontinental flights; a differential on landing fees at Heathrow between peak and off-peak periods; a frequency rebate on Gatwick landing fees; "every possible encouragement" for private and executive aircraft to use Gatwick; speeding up of the Heathrow multi-storey car park project; and the provision of duty-free shops. All possible methods of expanding cargo facilities should be examined, and at least one runway should be provided at Gatwick suitable for modern jets to take off fully loaded. An immediate detailed study of the prospects of Stansted as a third London airport should be made, and the announcement of a firm decision regarded as a matter of some urgency.

ECONOMIC DISTRESS SIGNALS

AS briefly recorded last week, most fares in Europe are to go up on November 1 by five per cent. This is to be an "across-the-board" increase, applicable to all IATA fares on most international routes in Western Europe with the exception of services to Spain, Portugal and Greece. Chairman of the Paris conference that agreed the rise was Mr K. A. Kristiansen of SAS, who spoke of the need to meet increased costs; however, he said, since the increase was smaller than the rise in income levels, it would probably not affect traffic growth.

First hint of the increase came out at a recent ATLB hearing, when BEA said that though they favoured fare reductions, they would "go along" with this rise. A graph on page 130 shows how the European fare level has risen since 1957. There has been no across-the-board reduction since tourist fares were introduced eight years ago.

Footnote: A meeting in London on July 18-20 of North Atlantic IATA operators failed to agree on proposals for new promotional fares designed to stimulate traffic. Big jet load factors, according to one estimate, are this season down in the 30s.

BREVITIES

An Aerolineas Argentinas DC-6 crashed on July 19 with the loss of all 60 passengers and seven crew. The crash occurred 45min after the DC-6 had taken off from Buenos Aires for Comodoro Rivadavia.

Cambrian Airways carried 23,141 passengers in the first six months of 1961, an increase of no less than 88 per cent over the same period in 1960.

Dan-Air's seasonal service linking Bristol, Cardiff and Swansea to Basle, which opened on July 8, may eventually be operated all the year round if traffic is sufficient.

Caribair (Caribbean-Atlantic Airlines Inc) has ordered three Eland-powered Convair 540s at a cost of $1m each. They will be fitted with up to 60 seats and will go into service at the end of the year.

Sabena made a loss of 131,735,947 Belgian francs (about £1m) in 1960, which was 65m francs less than that of 1959, in spite of revenue losses caused by the Congo airlift last July. Capacity increased by 38 per cent, while traffic increased by 45 per cent.

Permission was last week given by the Air Transport Licensing Board, in a quick emergency decision, for Air Safaris to fly to Spain 300 passengers who were to have gone by Falcon Airways. Sky Tours, the travel agents, had been informed by Falcon that they had no aircraft available.

A new set of salary scales awarded by the Industrial Court to BOAC's 1,010 pilots results in increases of £963 a year for senior captains (first class) of Boeing 707s and £923 for senior captains (first class) of Comet 4s.

The CAB has recommended to the President that permission be granted for Cunard Eagle to take over the foreign air carrier permit of Airwork awarded for the latter's transatlantic all-freight services operated in 1955. This permit is for Cunard Eagle's proposed freight service to the USA, and does not apply to the proposed New York passenger service, for which a foreign carrier permit has not yet been applied.

Appointed general manager of Air Afrique is Mr Roger Loubry of UAT. Air Afrique's base is in Abidjan.

Comet 4Cs of UAA are now serving Moscow Sheremetievo. The new Moscow - Cairo service is in partnership with Aeroflot Tu-104s and Il-18s.

Airmotive Supply (London) Ltd, has recently been formed as an offshoot of the Airmotive Supply Corp of Dallas, Texas. Managing director is Gp Capt P. R. W. Wickham, DSO, DFC, and the address is 28 Victoria Street, London SW1.

Swissair is due to take delivery of its two leased Convair 880s on August 7 and August 15 and are due to go into service on September 15. The two 990s for the Swissair/SAS consortium are scheduled to go into service early next year, following deliveries in the autumn.

A public meeting was to be held at the Horley Hotel, Camberley, today, July 27, at 8 p.m. to discuss plans for the possible re-opening of Blackbushe as an airfield for private and business aircraft. A Blackbushe aero club has been formed and the Ministry is reported by one of the interested parties "as being helpful."

A series of agreements between member airlines of IATA and shipping companies of the Trans-Pacific Passenger Conference (TPPC) make it easier for travellers between North America, the East and Australasia to fly one way and go by ship the other way. These agreements are basically similar to those for the Atlantic between IATA and TAPSC described on page 132 of *Flight* for July 22, 1960.

The Guild of Air Pilots and Air Navigators has awarded Master Air Pilots' Certificates to the following: Capt M. L. H. Carter, BEA training captain and line pilot; Capt R. P. Grimwood, DFC, BEA Viscount 800 flight captain; Capt T. G. D. Roberts, AFC, DC-4 training captain with TAA; Capt H. Tamblyn, DFC, TAA assistant senior route captain; Wg Cdr W. Jones, OBE, chief instructor of the Karachi Aero Club.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

ATLB Echoes

FROM your exhaustive reports of the ATLB proceedings, one cannot glean any hint that the question of parallel operation has been presented as anything but a simple yes/no decision. This seems an over-simplification; in the case of domestic services several possibilities come to mind.

Gatwick can be regarded quite legitimately as a separate traffic-generating area, and carriers licensed to operate to provincial cities without restriction. Only the Bradshaw breed, bound for Central London, would reject forty minutes in a minicab in favour of fifty in train and taxi—plus another twenty, equally split between a storm-swept station and the taxi queue at Victoria.

Licences for trunk services from Heathrow to Belfast, Glasgow and Edinburgh could specify an intermediate landing at Liverpool, Leeds or Newcastle, for example. No one would choose such stopping services if seats were available on through flights. A condition for a licence Heathrow - Manchester might be that no "turn-around" flights were to be scheduled. The aircraft might go on to Carlisle, Newcastle, Dundee or Aberdeen.

Such regulatory devices would advance domestic air transport far more than simple restrictions on frequencies and timings, and would improve the present inadequate services, without hurting BEA unduly.

However, before being too kind to BEA, one should remember the taxpayer, eager to see a diminution of the corporation's requirement for Exchequer capital, which is budgeted as £19,200,000 for 1961-62. He would see the owners of passenger ships applying to the ATLB for permission to re-deploy their capital from a dying industry, and he might wonder why they should be prevented from doing so at his expense. His case does not seem to have been put at the hearings.

London, WC2 A. J. LUCKING

AS a mere airline passenger, I suppose my views on civil aviation will be considered ultra-naïve. I have been reading in *Flight* the reports on the wranglings at the ATLB hearings and am more than ever convinced that the whole aviation set-up in this country (and most other countries) is geared to serve the carriers.

The only *necessary* licensing for aviation is that for aircraft airworthiness and crew competence. The only *necessary* control is air traffic control.

Now for the naïve question. Why can't any operator who wants to fly anyone he wants, anywhere he wants, as often as he wants at any fare he cares to charge to attract traffic?

I know that most of the civil air transport industry would throw up its hands in horror at such free-for-all circumstances but the above are the only conditions that would truly serve the interests of the passenger.

Someone at the ATLB hearings had the effrontery, twice, to say that the national airlines must be protected, otherwise the taxpayer would have to foot the cost of the deficits. What a state of bureaucracy to sink to! The sooner the State divests itself of its airline interests the better for the public. We all know what huge sums we are going to pay next year to compensate for this year's long-haul traffic flying half-empty at a time of re-equipment with the most expensive aircraft ever.

For the second year running, our State monopoly airline is at a standstill through an industrial dispute. Because there is no British alternative, passengers are scrabbling around seeking transport with foreign carriers. More huge sums of money for the taxpayer to make good!

Harlow, Essex BASIL L. JACKSON

Benevolent Fund's Founder

From AVM Sir John W. Cordingley, KCB, CBE, RAF (Ret)

THE autumn a new statue will look down upon the London scene as we celebrate Battle of Britain Sunday in the Abbey on September 17 at the close of Battle of Britain Week. A permanent memorial to Viscount Trenchard, the first and ever-lamented Marshal of the Royal Air Force, now stands by the new Air Ministry—surely also his living memorial—on Victoria Embankment. We of this Fund rejoice that this should be so—for he was our founder too.

The year that has brought this great honour to him who did so much for the Royal Air Force and the country has also seen the RAF Benevolent Fund pass a notable milestone by having, since its foundation in 1919, expended £10m on relief of distress among serving and ex-Service members of the Royal Air Force, Women's Royal Air Force, their families and dependents.

In past years you have very kindly drawn your readers' attention to the Fund's work and I wonder if, in my last year as Controller, I may ask you to contemplate doing so once again.

Last year, to achieve its aim and objects, the RAF Benevolent Fund spent £527,979—an average of more than £10,000 each week and an increase on the previous year, when £495,500 was spent. When I tell you that there were 12,585 successful applications for aid in 1960, bringing the total of such applications since 1919 to 443,814, you will appreciate the vastness of our responsibilities and sense the wealth of our rewards in terms of human happiness. For example, the son of a flying officer killed in action recently wrote: "I have been offered a place at Oxford . . . and would like to thank [the Fund] for enabling me to have the wonderful education I have had. At school the fact that fees have to be paid is taken for granted and it is only later that someone in my position realizes how lucky he has been."

In 1960 we had to make a greater expenditure on a smaller number of cases, which may well be a warning of the long-term trend: inflation and advancing age of those who fought the last war are two baleful factors that make it essential to exert all possible efforts to raise money now.

London W1 JOHN W. CORDINGLEY,
Controller, Royal Air Force Benevolent Fund.

The Dewoitine fighter referred to below by Mr D. C. Fuller

Manston Medley

I WAS recently given a number of photographs taken, I am told, at Manston between the wars. These were all taken on the same day and include the following assortment of aircraft: A.W. Whitley; D.H.60 Moth; Hawker Tomtit; Cierva C30A; Vickers Victoria; Westland Lysander; Hawker Demon; Hawker Hart; Gloster Gauntlet; Bristol Bulldog; Fairey Hendon; H.P. Harrow; Avro Commodore; D.H. Hornet Moth; Westland Widgeon.

Also included was the enclosed photograph [reproduced here—Ed] of a Dewoitine fighter, which I presume is the D.500 mentioned in Mr Planter's letter (*Flight*, July 13). Perhaps you, or one of your readers, can give some reason for this varied assortment of aircraft being based at Manston—was it the Air Ministry evaluation unit?

Ramsgate, Kent D. C. FULLER

Balloonist Aviators

IN P.P.O.'s "Private View" (p 893, June 29) he says "The group who formed it [the Royal Aero Club] were balloonists—who, in those days, were the only aviators." Is not this a contradiction in terms? Neither the Oxford Shorter nor Stubelius appears to think of a balloonist as an aviator and, since the word is presumably derived from "aviation," neither apparently does B.S. 185.

London W.1 P. DANTIC

Channel Mayday

AT 1056 GMT on Monday, July 3, Gemini G-ALCS took off from Deauville, after the rally, to proceed to Gatwick. The day was warm and the aircraft heavily loaded—two men, one woman, together with four people's baggage and ample fuel.

At 1129 the aircraft was almost exactly midway between Le Havre and Brighton when the port engine failed with a big bang, a lot of smoke and intense vibration. Two big-ends had failed, throwing one piston right out of the Gipsy 10 Mk 2 engine, carrying with it a section of the main oilway; and subsequent vibration broke both the front bearer feet out of the engine. A Mayday call was made, the engine throttled back and magnetos switched off.

Happily the engine did not fall out of the airframe and it was decided to return to France as there was a light northerly wind. Shortly thereafter the Mayday was cancelled and "Pan" substituted when it was found that the aircraft was maintaining height at 1,200ft at an IAS of 100 m.p.h. The aircraft passed over Le Havre and a landing was contemplated, but it was decided to continue to Deauville, where a landing was made without further damage.

This incident would appear to be a remarkable testimonial to the single-engine performance of a Gipsy Gemini, though it should be noted that this particular aircraft was fitted with fine-pitch metal props and had a number of other modifications incorporated to improve single-engine performance.

London EC3 J. M. HOULDER

[Indeed a remarkable testimonial and a lucky outcome. *Flight's* Gipsy Major Gemini with wooden propellers would not fly on one engine at 100 m.p.h., or hold height at that load. Congratulations!—Ed.]

CORRESPONDENCE...

Flight-deck Manpower

IN the correspondence columns of your issue of June 29 you printed a letter from Mr Potts of Melbourne in which he stated among other things that "navigators have been dispensed with" on present-day civil airlines.

This is an increasingly popular misconception, repeated, I notice, several times in various periodicals recently, and I would be grateful if you would correct the impression it may have made on your readers.

The fact is that all the world's airlines operating over international routes employ a full-time navigator, in some cases a pilot with a navigation licence, but nevertheless carrying out navigational duties. The vast majority of those so employed are specialist navigators.

The development of navaids, far from making the task of the navigator redundant, has demanded increased knowledge and skill now that the jet era has arrived. Aeroplanes fly higher and faster, upper winds are much stronger and more difficult to forecast accurately, and a much stricter adherence to track is now required. ETAs must be accurate. Gross navigational errors can no longer be tolerated.

With the coming of supersonic aircraft the job of navigation will become even more critical. The ability to assess the progress of the flight, *re* flight-planning and prognosis, not to mention monitoring the "black boxes" when they fail (and if we ever get them), will call for the highest skill and experience.

It is true that when communications became easier pilots were able to take over the duties of the radio officer, but the situation regarding navigation is much different. Navigation has not become easier; its function will always be carried out by someone. It is merely a question of politics who that someone is going to be.

Bournemouth, Hants V. R. PITCHER,
Executive Secretary,
International Airline Navigators Council

IN *Flight* for June 29 there is a letter about "Flight-deck Manpower." I'm greatly disappointed that you ever could print it, and I cannot agree with it at all. Let me give you some facts. At present there are over 1,000 navigators employed in civil airlines flying all over the world, from DC-3 to the latest jets, such as the 707 and the DC-8. I do not know how many navigators there are in the different air forces.

I personally think Mr Potts has never been in a jet-cockpit over the North Atlantic, South Atlantic, Pacific or on a Polar route, otherwise he could not write that letter. So far there is no airline flying the above routes without a navigator. I do agree in some airlines he is a pilot, but he is still doing the job of a navigator, and is even called so.

I am an active navigator, and received my training through the universally known school of AST in Hamble. So far I always thought that navigation is more respected among the people in the Commonwealth.

The so-called "instrument navaids" are the dreams of some people. These boxes are my special interest and form a part of my duties. I have done operational research with Dectra, Doppler, free gyro operations, e.g.; these are parts used for modern jet-navigation and they do not replace the navigator.

The present situation on the North Atlantic during the peak months brings high economic penalties on the carriers due to the ATC separations. If Mr Potts' "instrument navaids" would solve the problems, he is requested to send his ideas to the different ATC centres.

A high navigational standard of all airlines is needed to solve part of these problems, and this can only be done by a combination of the "black box" with the human navigator. Some people may soon have to revise their opinion on navigation, otherwise I doubt very much that the airlines can operate safely and efficiently on the North Atlantic in the future.

Kloten, Switzerland H. NAFZGER

FORTHCOMING EVENTS

July	27-29	International Business and Touring Aircraft Competition, Kidlington.
July–Aug	30–7	Derbyshire and Lancashire Gliding Club: Northern Gliding Contest.
Aug	1-13	Italian Gliding Championships.
Aug	27	Forli Rally.
Aug–Sept	27–3	Swedish Parachute Club: International Contest, Uppsala.
Aug–Sept	29–2	International Light-aircraft Exhibition, Luton Airport.
Sept	3	Wolverhampton Aero Club: At Home.
Sept	3-14	8th Anglo-American Aeronautical Conference (joint IAS/RAeS/CAI), London.
Sept	**4-10**	**SBAC Exhibition and Flying Diplay, Farnborough.**
Sept	6-10	FAI: European Air Tour.
Sept	8-10	Popular Flying Association: Rally, Cranfield.
Sept	9	British Air Mail Society: Golden Jubilee Exhibition and Dinner, Windsor.
Sept	11-15	Royal College of Advanced Technology, Salford: Course on Noise Measurement.
Sept	11-17	Battle of Britain Week.
Sept	13-17	German Aero Club: 2nd International Sporting Pilots' Rally, Baden-Baden.

THE INDUSTRY

Castrol Ltd have entered into contracts to acquire 75 per cent of the share capital of Melwood Thermoplastics Ltd, Harpenden, and the entire share capital of Tensile Products Ltd.

Alcan Industries Ltd, formerly Northern Aluminium Co Ltd, announce that as from July 1 their Luton sales office territory will take in Oxfordshire and the southern portions of Buckinghamshire and Essex formerly covered by their London sales office. The company's Luton office, which opened at 57 Bute Street, Luton, in January 1956 as a regional office under the London sales office, now assumes area status.

E. K. Cole Ltd announce "with deep regret" the death of Mr E. R. Pring, who joined the company as a director in the first year of its formation, 34 years ago. He retired from business activities last year.

Mr Charles Calderwood, chairman of the Spurling Group of companies, has been appointed a deputy lieutenant for the county of Middlesex.

The first Ekco transistor inverter to receive unlimited ARB approval is the Ekco type E210. A fully transistorized single-phase instrument, the E210 incorporates facilities for general-purpose applications and is stabilized against variations of input voltage and output load.

Ground power units for starting and servicing Comet 4Cs of Middle East Airlines, manufactured by Auto Diesels Ltd, a member of Braby of Britain Group, are going into service at Beirut Airport. The contract is worth £30,000.

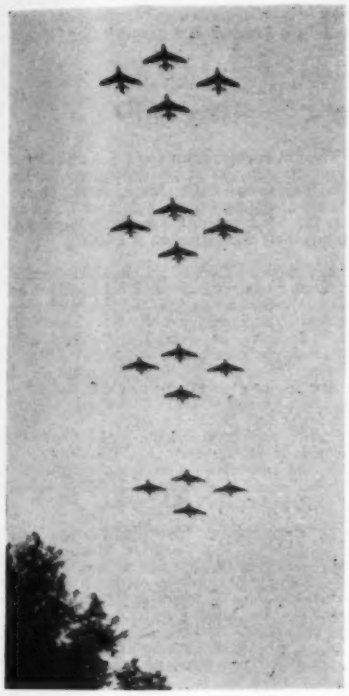
Glacier Metal Co Ltd state that arrangements are well advanced for the formation of a subsidiary in South Africa which will manufacture plain bearings. Glacier will hold the major proportion of the equity capital, initially to be about £50,000.

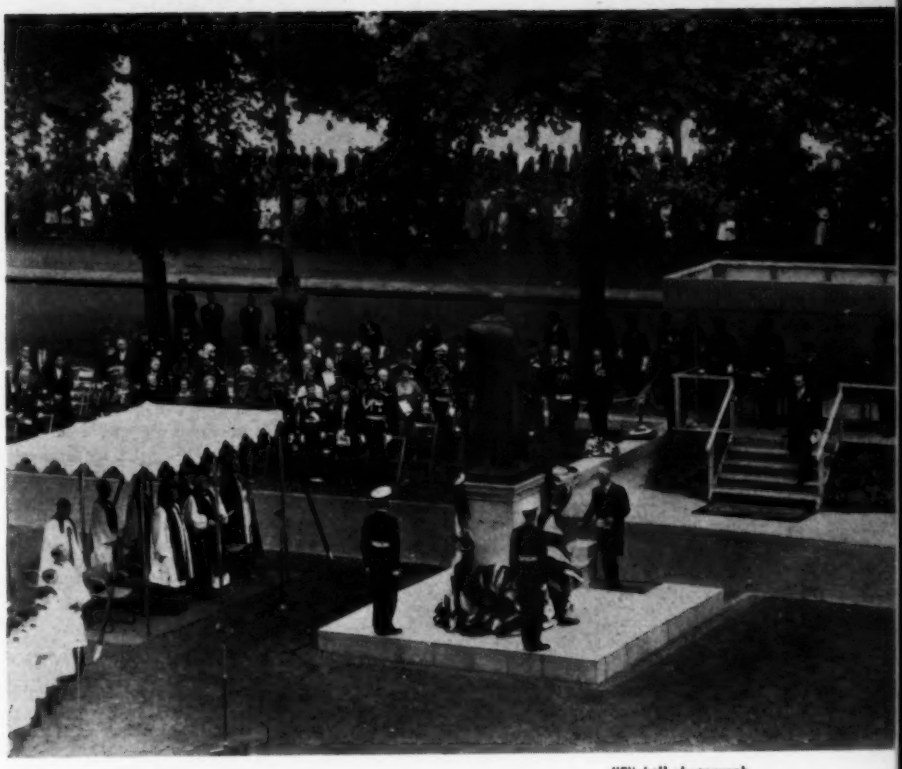
Mr Alex Duncan, ARAeS, president of the Mexican company Duncan y Cossio SA, Mexico City, which includes representation of British manufacturers in the Mexican aviation market amongst its activities, will be in England during August and for the SBAC Show and can be contacted via the Royal Aero Club.

Seen at Coventry Airport, where they made their first public appearance during the recent King's Cup Race and Lockheed Trophy competition: one of the two Shell-Mex and BP "Don" fuellers for helicopters and light aircraft, designed to carry any grade of aviation fuel on public roads and first used at York on June 8 to refuel the Vertol 107 which took guests to the Duke of Kent's wedding. Designed and built by Zwicky Ltd of Slough, on a Bedford TK 7-ton chassis, the Don has a total capacity of 1,000 Imp gal in two compartments "Flight" photograph

SERVICE AVIATION

Air Force, Naval and Army Flying News





"Flight" photograph

The Prime Minister, Mr Harold Macmillan, unveiling the Trenchard Memorial on Victoria Embankment, London, on July 19 as sixteen Hunters of No 92 Sqn (left) flew overhead in salute. The statue (below) depicts Viscount Trenchard in the full dress uniform of a Marshal of the Royal Air Force. His was the first appointment—in 1927—to this highest RAF rank

Commemorating Viscount Trenchard

"LORD TRENCHARD was a great man: great in stature, great in spirit, great in courage and great in achievement. To no one man are we so indebted for all that the Royal Air Force has done for this country in the past and for all that it does today as we are to him.

"He established the standards which those who came after him have maintained. He inspired the new Air Force with faith in its own future as a great Service. He moulded it on lines which have stood the test of time and technical advance."

Thus the Prime Minister, Mr Harold Macmillan, speaking when he unveiled the memorial statue of Viscount Trenchard in Victoria Embankment Gardens, London, outside the main Air Ministry building and next door to Scotland Yard, Trenchard's headquarters when he was Commissioner of the Metropolitan Police. The statue, which was dedicated by the Archbishop of Canterbury, Dr A. M. Ramsey, looks out towards the RAF and RFC Memorial on the bank of the Thames (surely no London statue has a more appropriate position?): slightly larger than life-size, it is the work of Mr William McMillan and stands on a Portland cement pedestal designed by Sir Albert Richardson.

Viscount Trenchard, GCB, OM, GCVO, DSO (1873-1956), was the first Marshal of the Royal Air Force—appointed in 1927—and first Chief of the Air Staff (1918-29). He foresaw the need for a training establishment for the RAF, on the lines of the Royal Military College, and the RAF College at Cranwell was the result. (Similarly, when Commissioner of the Metropolitan Police from 1931 to 1935, he founded the Hendon Police College.) At all times Trenchard fought for the independence of the service he had done so much to bring into being in 1918, and his title "Father of the Royal Air Force" was earned by his lifelong devotion to its furtherance and well-being.

[*Other Service aviation news: page 138, overleaf*]

"Flight" photograph

Hunter FGA.9 of No 208 Sqn at Kuwait (top left) with a Beverley in the background. Behind the Beverley is a Gannet AEW.3 of the Royal Navy. Below left, a Canberra B(I).8 landing; and above right, a Pembroke of No 152 Sqn, which also operated Twin Pioneers into Kuwait. (See "Kuwait Support," below)

SERVICE AVIATION . . .

Whitehall and Singapore

TWO appointments to air commodore posts are announced by Air Ministry: Gp Capt A. Foden becomes Director of Telecommunications at Air Ministry after being Command Signals Officer, RAF Germany; and Gp Capt L. H. Greenman becomes STSO at FEAF headquarters after commanding No 30 MU at Sealand, Chester. Both officers become air commodores in their new posts.

Kuwait Support

A BEVERLEY of No 84 Sqn, from Aden, was the first military transport to touch down on Kuwait's 3,000yd runway during the airlift of July 1-7. It had aboard the ground crew of No 8 Sqn, one of whose Hunters arrived ten minutes later, closely followed by others from 208 Sqn which had flown from Kenya. The Hunters were fully operational on arrival.

Despite sandstorms and heat, and the lack of approach and radio aids, RAF transport aircraft continued to arrive regularly. In all, some 70 were used, most of them within the first 48 hours. This figure was given in the House of Commons on July 19 by the Air Minister, Mr Julian Amery, who said that three Royal Rhodesian Air Force aircraft and 17 chartered civil machines were also used in the first six days of the operation. About 7,000 men and 700 tons of stores were moved to airfields in the Persian Gulf and Aden.

CSDE's Royal Visitor

TODAY (July 27) the Duke of Gloucester is to visit the RAF Central Servicing Development Establishment at Swanton Morley, Dereham, Norfolk. He will be met by the AOC-in-C Maintenance Command, Air Marshal Sir Leslie Dalton-Morris, and is making a tour of the station.

The establishment's main aim is "to foresee and plan in the field of servicing the varied technical equipment used by the RAF, minimizing the work, and generally reducing maintenance costs." AVM D. W. R. Ryley is AOC the group of units which include Swanton Morley, and the officer commanding is Gp Capt R. E. W. Harland.

Justifying the Cost

DESCRIBING Bomber Command as "the most flexible form of strategic strike force in the nuclear age," the Air Minister, Mr Julian Amery, said recently that Russia's development of three new types of aircraft justified Britain's great expenditure on Bomber Command. The Soviet decision to develop these aircraft confirmed the RAF view (he told the Tees-side and South-west Durham Chamber of Commerce) that the development of rocketry by no means marked the end of the manned aeroplane. Referring to Kuwait, Mr Amery said that expansion of Transport Command's long-range air fleet had enabled them to move in enough strength in time to prevent aggression.

IN BRIEF

Two instructors from No 1 School of Parachute Training at RAF Abingdon, Flt Lts John Thirtle and Peter Hearn, passed a baton while free-falling from a height of 7,500ft on July 18. After passing the baton they separated, pulling their ripcords when at 2,000ft.

A Canberra T.13 of the RNZAF bomber OCU at Ohakea made what is believed to be the fastest-ever crossing of the Tasman Sea when it flew from overhead RAAF Richmond, near Sydney, to overhead Ohakea—1,210 miles—in 2hr 18min.

The point-to-point record set up by a Hunter FGA.9 between London (Farnborough) and Malta on April 25 has been officially confirmed by the FAI. Piloted by Wg Cdr Harry Bennett, OC Flying at Stradishall, the aircraft covered the city-centre distance of 1,298.14 st miles in 2hr 3min 8sec at an average speed of 633.3 m.p.h.

Lt R. Learoyd of the Royal Marines is the first officer in the Corps to specialize as a helicopter pilot under a new scheme to provide RM commandos with a proportion of their own aviators. In future the Marines are to select officers to fly some of the helicopters in the commando carriers *Bulwark* and *Albion*. They are to have 12 months' flying training followed by two years in a commando helicopter squadron.

Air Marshal Sir Wallace Kyle, AOC-in-C Technical Training Command (at left), with his 18-year-old son Richard after the latter had received the Norton Sword, highest award for his entry of Technical Cadets (University) from the Secretary of State for Air at the recent Henlow graduation parade

At right, Capt H. A. Traill, group servicing manager, Westland Aircraft, presenting the Wessex Trophy to Lt Cdr A. L. L. Skinner, CO of 815 Sqn, when the squadron was commissioned recently at RNAS Culdrose

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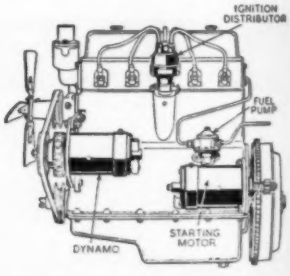

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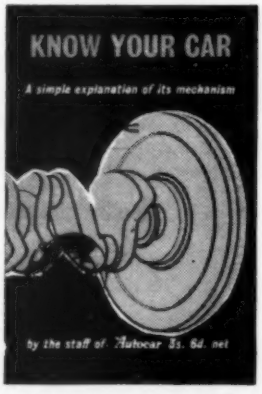

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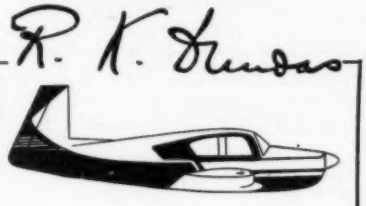

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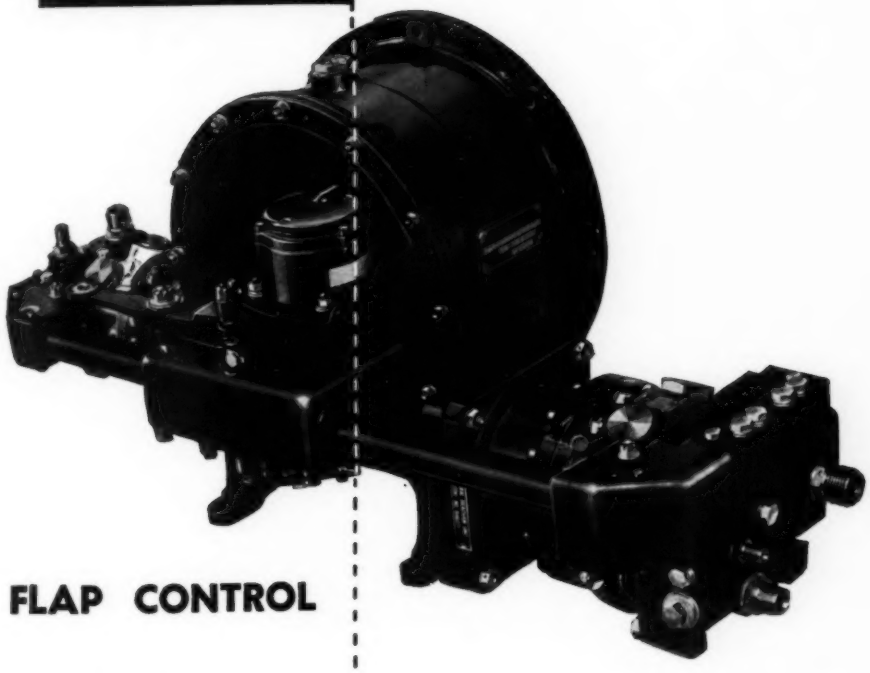

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